$4.00 a Year Published Monthly 50c a Copy

JUL 17 1940

VETERINARY MEDICINE

AUGUST 1940

CONTENTS

Educational Opportunity for Reserve Officers....422
The Washington Meeting of the A. V. M. A....424
The Dog Food Program....425
Medical Preparedness....427
"Ethical" Serum Producers....428
Reserve Officers Desired for Laboratory Duties....428
Caprine Quintuplets....428
The Newspapers Say....429
Early History of Preventive Medicine....430
The Control of Bang's Disease by Slaughter....436
Fatal Case of Erysipelothrix Infection....446
Recent Materia Medica: V. Vitamin B_1....447
Useful Prescriptions....453
Effect of Phenothiazine on Roundworm Larvae....454
Practical Methods of Poultry Disease Control....458
Anomalies of the Bird....461
Effect of Hookworms on the Coagulation of Blood....462
Proper Amount of Barn Air for Cows....464
Acetonemia and Post-Parturient Indigestion....464
Fibrosarcoma in a Mule....464
Vegetative Endocarditis of the Aortic Valve....465
Multiple Hematomas in the Spleen of a Dog....466
Stable Fly a Source of Trouble....466
Book Review: Chemistry and Medicine....467
B. A. I. Merges Biochemic Division and Other Units....468

VOL. XXXV
No. 8

Entered as second-class matter Nov. 8, 1920, at the post office at Chicago, Ill., under the Act of March 3, 1879.

7632 S. Camden Ave.
Chicago, U. S. A.

Old Wine

Quality is independent

IT COMES ONLY TO THOSE WHO SEEK IT

It will not be found where it is not appreciated

It enriches those who possess it, and continues to serve when all else has gone

Every Veterinarian prefers quality Products and can have them if he will SPECIFY AND INSIST

The slight additional cost is of small significance

PRODUCTS BOUGHT ON PRICE SOON PASS AND ARE FORGOTTEN—QUALITY ALONE ENDURES

Merillat-Laine Products become old friends, and, like old wine, gladden the owner

CALL THE ROLL

of

Our Sources of Supply

Abbott Laboratories, Bauer & Black, Becton-Dickinson, Cutter Laboratories, Doho Chemical Corp., Davol Rubber Co., Fromm Laboratories, Lehn & Fink, Mallinckrodt, Merck & Co., S. B. Penick, Swift & Co., and many others.

If you have confidence in them, you can have confidence in us.

MERILLAT-LAINE CO., INC.

1827 South Wabash Avenue

CHICAGO ILLINOIS

VETERINARY MEDICINE

Registered in U. S. Patent Office

VOL. XXXV AUGUST, 1940 No. 8

Published Monthly by the

VETERINARY MAGAZINE CORPORATION

7632 S. CRANDON AVE., CHICAGO, ILL., U. S. A.

$4.00 a year; per copy 50 cents; Special Issues $1.00

All matter appearing in this publication is copyrighted. No part of it may be reproduced without specific permission. Permission will be given if the purpose is unobjectionable. If there be any question as to the propriety of reproduction the author will be consulted.

D. M. CAMPBELL, *Editor*
7632 S. Crandon Ave., Chicago, Ill.
Telephone South Shore 7160

H. J. MOSTYN, *Eastern Representative*
1265 Broadway, New York, N. Y.
Telephone Murray Hill 4-4037

COPYRIGHTED, 1940, BY VETERINARY MAGAZINE CORPORATION

The report of the Ellin Prince Speyer Hospital, New York City, for the four months ending April 30, shows 8,146 animals to have been treated, among them animals belonging to some of New York's wealthiest and most prominent citizens.

* * * *

Work stock on farms of the United States has steadily decreased since 1915, when horses alone numbered more than 21,000,000 head, while on January 1, 1939, the total was 10,800,000. Mules, however, showed a gradual increase in numbers until 1924, and have since rather evenly declined. The loss in numbers of these hybrids amounts to about 2,000,000 head since 1924, the total on January 1, 1939, being 4,382,000.

* * * *

Commissioner David F. Smith of the Utah State Board of Agriculture reported that meat plants in the smaller Utah communities where strict federal and state inspection is impossible are in a deplorable condition, and that 75% of these smaller meat plants should be closed until sanitary regulations can be strictly enforced. Under present conditions diseased animals are being marketed for public consumption. Many of the small slaughter plants are little else but shacks; many have no running water, and the meat is slaughtered in unscreened rooms where flies have access to the carcasses.

A new chemical agent, sodium paranitrobenzoate, has been found by O. M. Gruhzit of Parke, Davis and Company, to be successful in protecting mice against *Streptococcus viridans,* which has not been amenable to sulfanilamide therapy. It has not yet been tried on human patients, but conceivably may find a place in the treatment of such diseases as ulcerative or malignant endocarditis.

* * * *

The Mead, Johnson and Company's $1,000 award for advances in knowledge of the vitamin B complex was divided between W. H. Sebrell of the U. S. Public Health Service, who discovered that humans need riboflavin, and a five-man research team (Drs. Keresztesey, Stevens, Harris, Stiller and Folkers) of Merck and Company's research laboratories, who succeeded in synthesizing vitamin B_6.

* * * *

The number of cattle on Wisconsin farms January 1, 1940, was 3,406,000—the largest ever recorded for this state. Of these, 3,123,000 were dairy cattle. Swine totaled 1,701,000, the largest number for several years; sheep and lambs, 470,000, about the same as the previous year. Poultry showed a striking increase, with 16,550,000 chickens reported, as compared with 15,484,000 a year ago. Horses, however, declined from 515,000 to 510,000.

Educational Opportunity for Veterinary Reserve Officers

For a dozen years the Mayo Foundation has offered a medico-military training course for reserve officers of the Medical Department of the Army—medical, dental and veterinary reserve officers. The course is held in October and lasts two weeks, but some attend for only one week. Credit hours toward maintaining an active status are given up to 100 hours for full attendance, proportionately fewer for part time.

The training course is under the direction of The Surgeon, 7th Corps Area, Omaha. Enrollment is available to reserve officers of the medical department in all corps areas, limited only by the facilities for conducting the course. Applications from medical and dental officers greatly exceed the number that can be accepted, about 400. Applications from veterinary officers have heretofore fallen far short of filling their quota. An order from the Commander of the Corps Area in which the applicant lives is necessary for admittance to the class. Requests for information concerning the course next fall should be addressed to Col. F. L. Smith, Mayo Clinic, Rochester, Minn. Request for orders authorizing attendance should be addressed *without delay* to Corps Area Commanders. The training is rated as "inactive" and officers are not paid for their time nor reimbursed for their expense. There is no charge for the course. Regular attendance at lectures, demonstrations and clinics is expected.

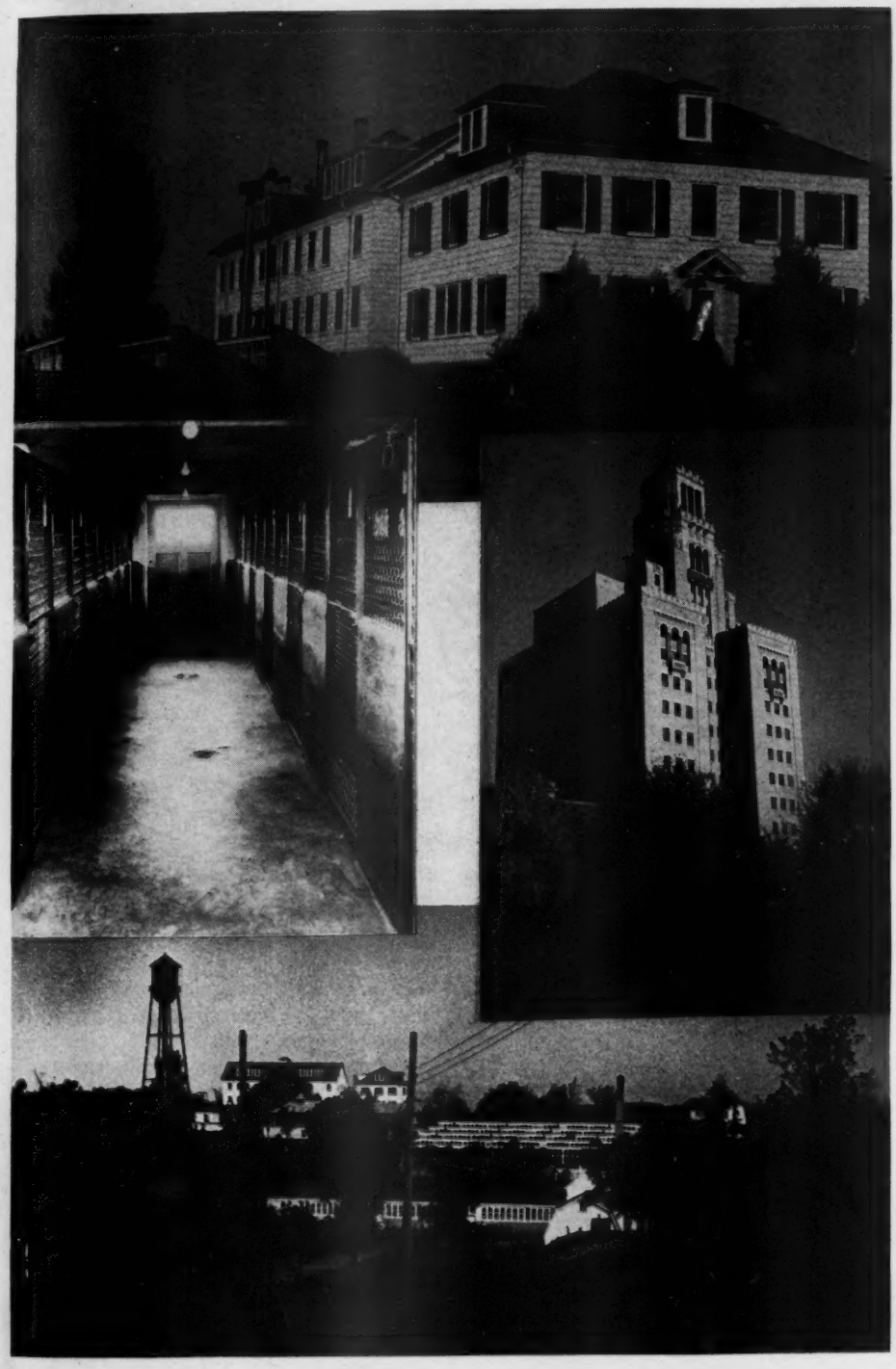
The course offers the best opportunity available to anyone to visit the world-famous Mayo clinics. About half the students' day is taken up with lectures by members of the clinic staff, by medical officers of the Army and Navy, and by invited guests. The lectures are approximately half medical, half military. The remainder of the day is occupied by attendance at clinics in various Rochester hospitals, terrain exercises and laboratory visits. The evenings are free, but student officers are welcome to attend meetings of the clinic staff and other medical meetings, which are held in Rochester nearly every night.

Veterinary officers are directed to attend classes and demonstrations at the Institute of Experimental Medicine most of the forenoons. Here their instruction, under the direction of Dr. F. C. Mann, is carried out largely by Drs. Wm. H. Feldman and C. S. Schlotthauer, and may include almost anything the class desires. Surgical operations and demonstrations such as Doctor Mann performed at the Chicago Meeting of the A. V. M. A. (1933) are in progress from 8 a.m. to 1 p.m. each day. Animal research and experiments by Doctor Feldman and numerous assistants may be observed and inquired about to the heart's content, or if one desires to see sanitation and practice under ideal conditions, Doctor Schlotthauer is ever willing to demonstrate on various of the Mayo farms nearby. All three are available and anxious to explain any type of research or investigation in which their visitors may be interested. Entertainment is not wanting. The class usually attends *en masse* a football game at the University of Minnesota on the intermediate Saturday.

Attendance at this Mayo medico-military course is a delightful experience, an opportunity to acquire much useful scientific information, to see in operation the most famous institution of clinical medicine in the world, and to hear lectures by the foremost medical and medico-military authorities. It furnishes a good opportunity for a physical checkup, too.

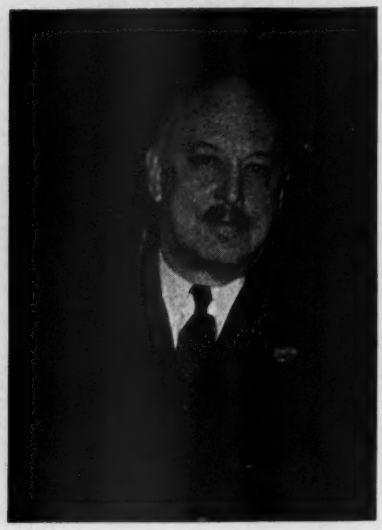
Doctor Mann will appreciate it if veterinarians will write him as soon as they know they will attend the course and indicate the type of instruction they desire. Only in this way can he and Doctors Feldman and Schlotthauer prepare in advance to demonstrate the things in which those who attend will be most interested.

Views of the Mayo Foundation buildings are shown on the following page. At the top: Laboratory building of the Institute of Experimental Medicine. Left center: Animal cages in the basement of the laboratory. Right center: Mayo Clinic building. Bottom: General view of the Institute, with the laboratory building in the background and experimental animal houses in the middle and foreground.



The Washington Meeting of the A.V.M.A.

The program for the 77th annual meeting of the A.V.M.A., to be held in Washington August 26-30, is complete. There are few changes in the entertainment features published in the May issue of VETERINARY MEDICINE. The literary program is long, varied and unusually attractive. It was published in the July issue of the official journal, and may be had in booklet form on application to the Central Office of the A.V.M.A., 600 S. Michigan Ave., Chicago.



John R. Mohler, Chief of the Bureau of Animal Industry, is Chairman of the Committee on Local Arrangements, and responsible for the excellent planning of the Washington Meeting

The broad appeal and the great interest presented by the subjects for discussion at the Washington Meeting, together with the attractions that the National Capital offers for visitors, should result in a large attendance and an unusually satisfactory meeting. Meetings of the Executive Board and of the House of Representatives will be held Monday, Aug. 26th; the opening meeting Tuesday morning and a general session in the afternoon; Wednesday, sectional meetings —Research, General Practice, Small Animals, Poultry, Sanitary Science; Thursday, a general meeting and a trip to Mt. Vernon, and Friday, the clinic. These, together with sightseeing, various luncheons and banquets, will fill the week.

Col. Raymond A. Kelser, Chief of the Veterinary Division, Surgeon General's Office, War Department, is scheduled for a discussion of rabies vaccination

Adolph Eichhorn, Director of the Animal Disease Station, Beltsville, Md., is Assistant Chairman of the Committee on Local Arrangements. He also will discuss rabies vaccination

On this and the following pages are featured some of the leaders who will contribute to the literary program.

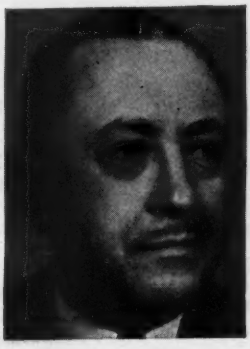
The Dog Food Program

Interest in the dog food testing program aroused by the publication of advertisements of dog foods which implied an endorsement of those foods by the A.V.M.A. in a manner very obnoxious to many members of the association, has led to its discussion

Congressman George W. Gillie is in charge of publicity for the Washington meeting

in VETERINARY MEDICINE (June, pp. 323-325; July, pp. 374-376). Any discussion of this kind is subject to the handicap of wrong impressions gained by the casual, indifferent, or careless reader. This discussion has been no exception in that some, perhaps a very few, have interpreted it to be an attack on the program. Of course, such is not the case, as more thoughtful readers cannot but realize.

In the June issue of VETERINARY MEDICINE the following statement occurs: "Surely a program the objects of which are so laudable can be so formulated as to receive general approval and support" and again, ". . . this whole matter needs reëxamining at the Washington meeting. There must be a better way"; in the July issue the following: "This dog food testing project should be reëxamined carefully at the Washington Meeting of the A.V.M.A. with a view to developing a better and a safer plan—one that will cause less dissension among our members and one that will work." Other statements of similar import leave no doubt of the intent of the discussion. The fact is, the real friends of the program are those who



Harry W. Schoening, Chief of the Pathological Division of the B. A. I., will present a paper on swine erysipelas

set about a study of it to determine the weaknesses and objectionable features which have prevented it from succeeding and seem destined to prevent it from ever succeeding. The wreckers of the program

William J. Butler, State Veterinary Surgeon and Executive Officer of the Montana Livestock Sanitary Board, is scheduled to present a paper on state veterinary service

are not those who, recognizing its failure, would modify, improve and safeguard it, but those who demand further effort to force its acceptance by the dog food industry, despite its evident shortcomings. As has

been stated repeatedly, the whole program requires reëxamination and calm study. This is the prerogative of the House of Representatives, with whom final responsibility rests. To the end that the right solution may be arrived at by such deliberations, discussion—the more the better—in advance of the Washington Meeting is desirable. A policy of suppressing information such as has prevailed consistently for four years is incompatible with an intelligent evaluation of the project by the membership at large. The following facts seem to be among those which should be known:

C. H. Covault, head of the Department of Veterinary Medicine, Iowa State College, Ames, will speak on problems in clinical diagnosis

1. The program was jammed through the House of Representatives at Memphis under misrepresentation. To-wit, the delegates were told the fee is $500, whereas it is $950, and that the dog food manufacturer paid the money (all of it) to the University of Illinois, (*J. A.V.M.A.*, October, 1939, p. 456), whereas the fact is the money is paid to the American Animal Hospital Association and approximately only 10% of it goes to the University for the test. It was stated that this matter is sponsored by the University of Illinois (*ibid.*), whereas the fact is, not only is the program not sponsored in any way by the University, but the use of its name in such connection is unauthorized.[1]

2. It has been the basic cause of differences, bickering and nagging between the business office of the A.V.M.A. and the governing body. Unfortunately, these dissensions have been dragged through the pages of the official journal.

3. The subject is unique in that discussion of it is deprecated by the governing board of the A.V.M.A. Within past months a variety of subjects of interest to veterinarians have been discussed in an informative manner in these columns without objection from anyone. But when a plea was made for a further study of this one to the end that the project might be revised and given a chance to succeed (*Vet. Med.*, June, 1940, pp. 323-325), members of the executive board and the dog food committees rushed into print with "answers" that leave as much as before in the realm of the unknown. Certainly they do not explain why any member of the association is committing lèse-majesté by expressing his opinions upon the subject, fairly and moderately. Apparently in an endeavor to promote the workability of a very worthy project we have trodden, inadvertently, upon some exceedingly tender toes. The outcome seems a good illustration of the wisdom of the old saying, "If you are right you need not lose your temper and if you are wrong you can't afford to lose it."

4. When this dog food certifying program was originated, some of its promoters envisioned a time when half of the dog food manufacturers would be seal holders, bringing the certifying group an annual income of approximately $100,000. The expense of testing these foods was placed at $10,000. Yet when the support of the A.V.M.A. was sought, not only was no proposal made for an accounting of the monies received, but it was specifically provided that such need not be made. It will be noted in the resolution providing for the endorsement of the A.V.M.A.[2] that the dog food committee of the A.A.H.A. will supply the Executive Board of the A.V.M.A. a copy of the former's report to the A.A.H.A. There is no statement of what the report will contain, and the A.V.M.A. has no authority to specify what information it is to receive.

. The income from seal holders is now over $4,500 a year. Expenditures in connection with the project have not been published.

[1] In this connection it seems pertinent also to ask why members of the Executive Board, who it was stated had thoroughly investigated the matter, did not correct the misstatement, three times made to the House of Representatives, that the cost of getting a seal of approval is $500. Also when these incorrect statements were published in the official journal, why did they hold their peace for seven months? Now that the facts have been brought into the open some of them are clamoring to be heard.

[2] *Vet. Med.*, July, 1940, p. 374.

Medical Preparedness

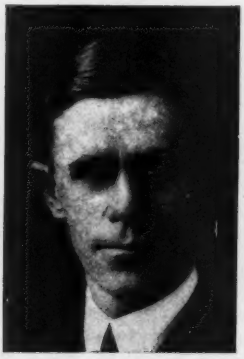
The American Medical Association has adopted resolutions pledging "unwavering support to the President for national unity and organization," approving the medical mobilization plan of the Surgeon General of the Army, providing for card indexing of physicians with their qualifications for tasks with the army and navy, and with recruiting boards, in industry or civil life, and appointing a committee to represent the medical profession in contacts with the War Department.

Mark Welsh, State Veterinarian of Maryland, Secretary of the U. S. L.S.S.A., will speak on Bang's disease vaccination

The prospects that the United States may become involved in the present European war, fortunately, seem slight at this writing and the preparedness activities of the A. M. A. may come to naught. Nevertheless, it has brought the medical profession a tremendous amount of favorable publicity, enhancing its prestige and building good will for it.

Arthur F. Schalk, Ohio State University, Columbus, will present a film showing the action of the ruminant stomach and the mechanism of the heart beat

"Veterinary Military History of the United States," referring to events in the spring of 1917 states, "Never was an army service or a profession put into a more disadvantageous position than was the veterinary service of the army and the veterinary profession of the country at the outbreak of the World War." This was due mainly to failure to act till the emergency was upon us and even then having no plan for action.



Ward Giltner (left), Dean of the Division of Veterinary Science, Michigan State College, East Lansing, will discuss state veterinary service. R. E. Rebrassier (center), Ohio State University, is presenting a paper on the control of gastrointestinal parasites of sheep. Clarence M. Haring (right), Univeristy of California, Berkeley, will present a paper on Bang's disease vaccine

"Ethical" Serum Producers

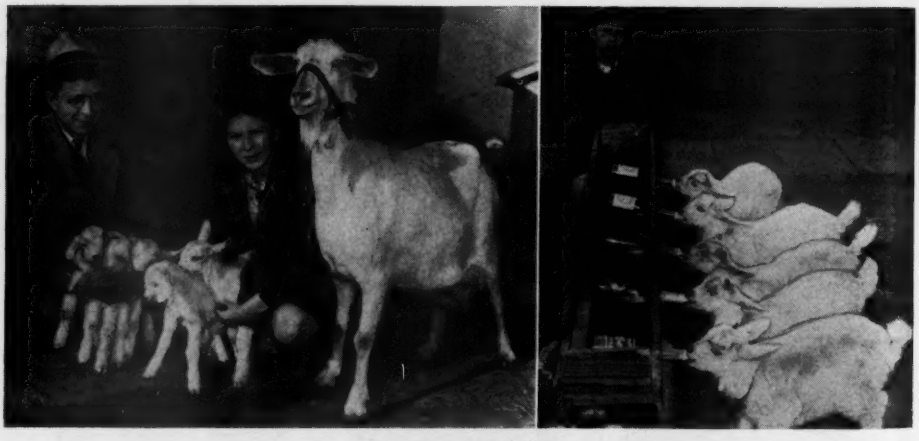
On page 368 of the June issue of VETERINARY MEDICINE reference was made to the undependability of anti-hog cholera serum made by certain of the serum producers who distribute their products direct to the swine owner, and it was pointed out that one should not be surprised to find that producers who are indifferent as to how their product is used should likewise be unconcerned as to how it is made, or that government officials should from time to time catch them distributing low-grade, diluted, or otherwise substandard serum.

In identifying the manufacturers who are jealous of the reputation of their serum and limit its distribution to those who are trained to use it—i.e., to veterinarians—and who may be presumed to be equally concerned about its quality, they were referred to as members of the Associated Serum Producers, Inc. This organization, as most readers know, includes the large "ethical" serum producers in the Corn Belt. As is generally known also, there are some serum producers in other sections, not members of this midwest organization, who distribute their products to the profession only and the quality of whose products is beyond question. The sheep-goat classification was, of course, based upon policies alone, and not upon membership or non-membership in the producers' organization, which is based upon both policies and location.

Army Veterinary Reserve Officers Desired for Laboratory Duties

To meet commissioned personnel requirements of our expanding Army, the Veterinary Corps has placed 27 Reserve officers on active duty and during the next few weeks will add 50 more. The assignments are for one year, but can be extended for a second year, possibly longer if conditions warrant.

It is planned to give a few veterinary Reserve officers specializing in laboratory work a special course of three months' duration at the Army Veterinary School, Army Medical Center, Washington, D. C., commencing September 15th, following which they will be assigned to various stations for laboratory duties. Interested Veterinary Reserve officers in the grades of First Lieutenant and Captain under 35 years of age who have special laboratory training should communicate immediately with Colonel R. A. Kelser, V.C., The Surgeon General's Office, Washington, D. C.



CAPRINE QUINTUPLETS

This unusual set of goat quintuplets was born March 7, 1940. They are shown at the left with Snowball, their proud mother; Mr. Gus S. Stringos, Hutchinson, Kans., their owner; and Miss Amy Lou Stringos; at the right, they are nursing from an improvised rack. Inevitably they were named Annette, Yvonne, Marie, Emilie and Cecile; at least these were their names until they arrived at the New York World's Fair, where they found that these names had been copyrighted by the Canadian girl quintuplets, who had planned their own show at the fair this summer. After a hasty rechristening, they emeged as Aphene, Cleopatra, Euterpe, Hebe and Media.—Leroy Atkinson, Hutchinson, Kans.

The Newspapers Say . .

Beware of handling swine infected with erysipelas, is the grim warning Dr. C. D. Grinnells, veterinarian of North Carolina State College, offers to farmers of North Carolina. "We have received reports from the American Foundation for Animal Health that swine erysipelas is spreading rapidly in 39 states, and North Carolina is one of them," he said.

"Human beings are dangerously susceptible to the same germ which causes swine erysipelas, and farmers should be extremely careful in handling diseased hogs," the veterinarian continued. "More than a thousand such cases of human infection have already been reported in the country."—*Ahoskie* (N. C.) *Herald.*

Swine erysipelas being already a serious disease in this country and the cause of greater losses in Europe than any other disease of swine, it is strange that the scientists of the N. C. college have not thought to advise farmers, in the interest of both economy and public health, to call in an expert to handle outbreaks and suspected outbreaks. But North Carolina is another of those states which are short of veterinarians—and will so continue while the present official policy exists.

* * * *

County Agent Gets Timely Tips

Assistant county agent Errol D. Anderson uses a whole column in the *Battle Lake* (*Minn.*) *Review* to explain that heretofore as early summer arrived he has been besieged with letters asking about pigs "having scours, worms, necro or mange" and baby chicks "dying from coccidiosis and worms." In the past he has seen high hopes too often "shattered by worms and diseases that cause large losses of animals and investment." All this is to be changed henceforth, for Mr. Anderson has now "secured tips and advice on this subject for West Otter Tail County farmers from W. A. Billings, extension veterinarian, University Farm, St. Paul." Mr. Anderson urges his charges to cultivate a skepticism as to the claims of "innumerable cure-alls," in particular one that claims to absolutely prevent or cure hog cholera. He states that if these cure-alls "did only half of what is claimed for them we would all get on the bandwagon and preach their acceptance."

Illinois farmers are using more anti-hog cholera serum and virus in protecting their 1940 pig crops than in previous seasons, according to a report received by the Kane County Farm Bureau from the Illinois Agricultural Association.

On April 30, more than 7,000,000cc of serum were secured by farm bureau cooperatives for members. This compares with 6,860,000cc for the same period a year ago and 5,080,770cc, the five-year average.—*Aurora* (Ill.) *News.*

The loss from animal disease in Illinois is greater than in any other state. In hog cholera losses likewise it tops the list. It has also "lost" 200 veterinary practitioners in a score of years; cause and effect or effect and cause. Thirty years after a near-perfect preventive of hog cholera was developed, the farm bureau buys and its members themselves inject more than 40 million cc's of anti-hog cholera serum annually, and the amount used is increasing year by year, as more and more outbreaks of hog cholera occur. That is disease control a la farm bureau.

Hog cholera is peculiarly a disease that is spread by the infected animal or its carcass. Forty-five years ago the state enacted a statute which provides that:

It shall be the duty of the owner or person having charge of any swine and having knowledge of, or reasonable grounds to suspect the existence among them of the disease known as "hog cholera," or of any contagious or infectious disease, to use all reasonable means to prevent the spread of the same, and upon its coming to his knowledge that any of such swine has died of, or been slaughtered on account of, any such disease, to immediately burn or bury the same to a depth of two (2) feet. . . . No person shall convey upon or along any public highway or other public grounds or any private lands, any diseased swine, or swine known to have died of or been slaughtered on account of any contagious or infectious disease.

That law is still in existence, but not in force. It can't be enforced because of opposition of hog raisers. It is more profitable (for the individual) to truck infected hogs to market and the dead and near dead to the rendering plant. Did anyone ever hear of the Illinois Agricultural Association sponsoring this very sane measure for lessening the loss of its members from hog cholera?

Early History of Preventive Medicine With Special Reference to The Viruses of Animal Origin*

By B. M. LYON, Pearl River, N. Y.

THE early history of active immunization with specific agents should have an especial appeal to the veterinary profession; not only the isolation of specific bacteria, but also the successful immunization against disease was first accomplished in infections which were primarily of animal origin.

In 1796, one of the greatest triumphs in the history of medicine occurred when the first successful active immunization was accomplished by an Englishman, Dr. Edward Jenner. Doctor Jenner vaccinated a boy with the pus obtained from a cowpox lesion on the hand of a dairymaid, and later inoculated the boy with pus from a smallpox patient, without resulting infection. Two years later, Jenner further proved that cowpox gives protection against smallpox by inoculating five children directly from the vesicle of a cow's teat. All were later inoculated with smallpox virus and shown to be protected. Within a year, vaccination against smallpox became general in Europe. It was introduced in the United States in 1800. Thus was established the relationship between Variola (cowpox) and Vaccina, and the first instance of active immunization by vaccination was recorded.

Additional noteworthy advances in immune therapy were not made until the time of Pasteur, almost a century later. It was Pasteur's classical experiments at attenuation and protective inoculation with the anthrax organism which formed the foundation for the modern concepts of immunity.

Anthrax was the first disease of man or animal shown to be caused by a specific bacterial organism. Pollender, in 1855, recognized the bacillus in the blood of animals with the disease. However, it was Koch and Pasteur, in 1876, who succeeded in growing the organism in an artificial medium, and reproduced the disease in animals from culture. A few years later, in 1880, Pasteur established that a modified or attenuated living culture of anthrax can be safely injected into animals, which, when so treated, are subsequently immune to artificial exposure. Pasteur demonstrated his claims successfully before a notable group of scientists, and from that time on, his method of anthrax immunization became widely adopted, and a possible solution for control of other infectious diseases was founded.

Almost simultaneously with the development of anthrax protective vaccination, Pasteur determined that by administering gradually increasing doses of rabies virus to an exposed animal, the disease might be prevented. In 1885, the Pasteur method of rabies treatment was first used in man. Thus was offered a successful method for immunizing against a disease which was mentioned as a malady affecting dogs as early as 1300 B.C., and was described by Aristotle in 300 B.C.

It is also significant that within this same epochal introductory period of preventive vaccination, the swine erysipelas bacillus was isolated by Thuillier and Pasteur, and these same scientists used a culture of the organism successfully as a vaccine to immunize susceptible swine.

Pasteur also in 1880 confirmed the previous findings of a bipolar organism in fowl cholera and carried out some of his first fundamental experiments on the attenuation of bacterial cultures and subsequent immunization which he successfully demonstrated with the bacilli of fowl cholera.

In 1884, the nature and etiology of the condition which we now refer to as tetanus,

* Presented at the 16th Annual Conference for Graduate Veterinarians, Alabama Polytechnic Institute, Auburn, Ala., March 20-22, 1940.

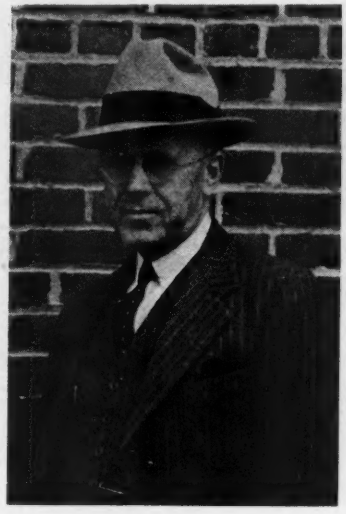
was established. Carle and Rattone produced the disease by inoculating into a rabbit the contents of an acne pustule obtained from a person who had died of tetanus. At the same time, the infective agent was shown to be a spore-bearing bacillus. Two years later, Nocard established that the same organism was responsible for tetanus in the horse. Still later, in 1892, Behring and Kitasato developed an effective method of immunization against the disease. These authors soon established that tetanus, which had in the past so frequently followed operations and injuries, could be prevented by injection of antitoxin. Thus was established the first prophylactic against tetanus.

Almost simultaneously, Behring developed an anti-toxic serum which he demonstrated would protect animals against diphtheria, and in 1893, he first applied the serum to the treatment of diphtheria in man. The success of these two antitoxic sera laid the groundwork for the development of other therapeutic sera.

All the vaccination methods introduced by Pasteur depended upon the development of active immunity by means of an attenuated living virus or organism. By this method, he was able to control three of the epizootic diseases prevalent in France, and to reduce the prevalence of rabies in man. Pasteur's method is the basis for the various forms of protective and therapeutic inoculation or vaccination in use today, whether a modified living, or dead culture is used. Unfortunately, the Pasteur living culture immunization could not be successfully extended to all diseases. Many important advances have since been made with other forms of vaccines or antigens.

In 1886, Salmon and Smith showed that in some instances it is not necessary to introduce living organisms to produce immunity, but that the same results may be obtained by injecting bacteria killed by heat or chemicals; also, by culture fluids from which the bacteria have been removed. It was these investigators who first demonstrated that an active, durable form of immunity can be induced with heat- or chemically-killed bacterial suspensions or the cultural filtrates of bacterial growth.

Wright, in 1896, introduced the killed cultures for immunization against typhoid fever, and largely through his advocacy,



The Author

inactivated or killed cultures have acquired an important position in active immunization and in the treatment of many chronic infections.

A noteworthy contribution to preventive medicine was made by Theobald Smith, one of the pioneers in bacteriology and immunology of infectious diseases, when he suggested the use of a mixture of diphtheria toxin and antitoxin for immunization of horses for antitoxin production. Behring later applied this method to the immunization of children. The most extensive study of this toxin-antitoxin method of immunization was made by Park and his associates of the New York City Department of Health, by which means many thousands of children were immunized.

The toxin-antitoxin mixture soon gave way to a more effective and desirable agent, toxoid, or anatoxin. This toxoid was introduced by Gaston Ramon, a French veterinarian who, in recognition of his many contributions to medical science, is at the present time associate director of the Pasteur Institute. Doctor Ramon treated diphtheria toxin with formalin and found that

it resulted in a complete loss of toxicity but retained its antigenic or immunizing power. As the result of Doctor Ramon's contribution, and the extensive use of toxoid im-

Louis Pasteur in His Laboratory

munization, diphtheria has been brought under control and no longer ranks as a serious menace to childhood.

A wide application of Ramon's discovery of the detoxifying action of formalin has since been made in the development of other valuable anatoxins and bacterial antigens, now so generally used in preventive medicine.

Louis Pasteur and Robert Koch are rightly referred to as the founders of bacteriology, the former in the main being responsible for modern methods of preventive inoculation against disease, while to the latter we owe the development of the correct theory of specific infectious diseases.

In America, Theobald Smith, in 1885, carried out immunization experiments in connection with his studies of swine diseases. It is evident, therefore, that the latter half of the 19th century marked the real beginning of the science of bacteriology and preventive medicine.

It is also noteworthy that the most important advances made thus far in the 20th century have dealt principally with preventive medicine.

Viruses

It is interesting to note that the first successful immunization was accomplished against a disease of virus origin, and also that rabies, one of the oldest diseases known, was shown centuries later to be a virus disease.

In defining diseases of virus origin in contrast to those of bacterial origin, the former may be defined as disease agents which cannot be microscopically demonstrated; which pass the finest filters retaining ordinary bacteria, and cannot be artificially cultivated upon any medium other than living tissue or within a susceptible host.

The true nature of filterable viruses has been the subject of controversy for years. By some they are considered as minute living bodies. The other school of thought considers them to be of the nature of enzymes, and not living structures. There is, now, however, quite general agreement that viruses are living bodies.

There are now approximately 39 diseases of virus origin affecting man, and some 37 affecting animals including fowl, with new virus diseases being recognized from time to time. Viruses have been classified by some into three classes—neurotropic, dermotropic, and viscerotropic. As examples of the neurotropic may be cited rabies and equine encephalomyelitis viruses. Typical of the dermotropic, are the pox viruses and vesicular stomatitis, whereas the influenza group is characteristic of the viscerotropic type.

Virus Cultivation

No disease classification or disease agent has been the subject of greater interest among investigators in recent years than virus diseases and their respective viruses. Research workers have been particularly interested in establishing their true nature, their identity, and especially in developing improved methods for their cultivation.

The ability to reproduce or cultivate the virus upon a suitable medium in sufficient concentration is a major factor in the successful development of antigens or vaccines for effective disease control. Virus cultivation to date is confined to media consisting

chiefly of living tissue or to propagation within the susceptible host. Various viruses differ greatly in their adaptability to growth on such media and are shown to be highly selective. Embryonic tissues have been found generally adaptable to the propagation of viruses, and of these, the chick embryo has proved most practical, as well as adaptable to the growth of the greatest number of viruses. The number of viruses which have thus far been successfully cultivated in sufficient titration and in suitable form for vaccine production are comparatively few. However, research workers and others are working vigorously on this phase in connection with virus disease control.

One of the best recent examples of the adaptability of the chick embryo as a medium for virus propagation is that of the equine encephalomyelitis virus. The success of the new, highly effective vaccine, which has brought this serious epizootic disease of Equidae under control, has been due mainly to the ability to secure an exceptionally high concentration of the infective virus from the inoculated embryo. It is reasonable to assume, all other factors being equal, that the effectiveness of a killed vaccine is in direct ratio to the amount of virus present prior to inactivation.

Many other disease-producing viruses have been cultivated successfully on the chick embryo or on the embryonic membranes, such as the various pox viruses, and those of laryngotracheitis, and vesicular stomatitis; and active vaccines produced therefrom have met with a measure of success.

Where killed or inactivated vaccines are dependent upon the propagation of the virus in the susceptible host, the chief difficulty is to secure virus regularly in sufficient titer to provide enough antigen for effective immunization.

A perfect example of a comparatively ineffective product due to low virus content, was the original equine encephalomyelitis vaccine, dependent upon the virus content of the diseased horse brain, which, at best, was of a low titer and extremely variable. It has been shown that the virus titration from an inoculated chick embryo is approximately 100,000 times greater than that recovered from horse brain.

Edward Jenner Vaccinating a Child

The same difficulty is experienced in preparing an effective rabies vaccine. It is essential to determine the virus content of the brain material from which the vaccine is prepared prior to inactivation, if we are to hope for a good product. Many attempts have been made to cultivate the rabies virus on the chick embryo, but the virus was confined to the brain of the embryo, resulting in the production of an insignificant quantity. Webster succeeded in cultivating the rabies virus on artificial media to which mouse embryo brain was added, but this also proved an impractical though interesting experiment, since the production volume possible was insignificant and the virus titration obtainable was no greater than that from a natural animal host.

Where a living, modified vaccine is to be prepared, the virus titer is of less concern, since the living virus may multiply its antigenic unitage after infection, whereas the antigenic stimulus of a killed vaccine is limited to the amount injected.

Theory of Adaptation

In the study of viruses and their corresponding syndrome, an interesting theory of possible adaptation for different species has been proposed. The supporters of such a theory cite as examples the several pox viruses which are more or less selective as to species. It is proposed that the marked similarity may indicate descendence from a single virus, which later, due to repeated passage through certain species, becomes more or less specific in pathogenicity for that species. These same investigators refer to the similarity and certain relationship of swine influenza to that of man, as shown by Shope's experiments.

Virus Transmission

Studies on the transmission of virus diseases have established many new data concerning possible modes of transmission and the existence of virus hosts.

Shope, in his study of swine influenza, has shown that the lung worm from infected swine may serve as an intermediate host for the influenza virus and as such, may act as a direct or indirect medium by which other swine may become infected.

Webster, in his rabies studies, states that virus has been recovered from normal skunks. He has noted also that mice artificially infected with rabies virus may become partially paralyzed and later recover, and that the virus may be found in such mice for some time following recovery.

Kelser proved beyond a doubt that equine encephalomyelitis may be transmitted by certain blood-sucking insects, the mosquito and also certain species of tick. Certainly, it is quite logical that septicemic virus, while present in the blood stream, may be transmitted by any insect capable of transferring blood from the infected animal to another susceptible individual. The discovery of many new susceptible species to the equine encephalomyelitis virus, particularly certain migratory fowl, has suggested these as possible additional modes of transmission, making the problem of the distribution of the disease more complex.

The interseasonal host of equine encephalomyelitis still remains a mystery, and although carriers in recovered horses have not been detected, they have not been disproved, and it may yet be shown that some newly-discovered susceptible animal or fowl, or the larva form of some of the transmitting insects, may act as interseasonal host.

Multiplicity of Viruses

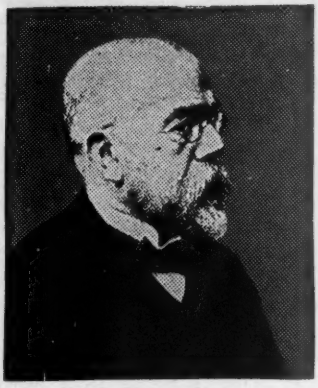
The multiplicity of viruses producing diseases with identical syndromes has repeatedly puzzled investigators and added complications to the disease control problem. There are now recognized three distinct viruses responsible for foot-and-mouth disease. In the United States, we have two viruses responsible for equine encephalomyelitis, designated as eastern and western because of their territorial distribution. Also, two additional viruses were announced in 1938, one from Russia by Howitt, and the other from Venezuela by our Laboratories. which produced a clinical disease identical with that of our American viruses. In vesicular stomatitis likewise, more than one virus is concerned.

These viruses are designated distinct and separate disease agents, in that they differ both immunologically and serologically. A vaccine prepared from one virus will not immunize against the other, and *vice versa*. Likewise, an immune serum prepared from the one shows no viricidal action upon the other.

As one of the best examples of multiple viruses producing the same syndrome, we might briefly review equine encephalomyelitis.

In 1930, Karl M. Meyer first announced the recovery of the virus of equine encephalomyelitis, which we now refer to as the western type. In 1934, the disease appeared in some of our central eastern seaboard states—New Jersey, Delaware, Maryland—and from these areas, the virus was recovered by the Federal Bureau of Animal Industry. It was noted that the disease in the eastern states was much more acute and the mortality rate much higher than that occurring in the western states. On the basis of clinical observation, it was first thought to be simply a matter of difference in virulence. The clinical picture was identical with the western disease except

that the horses succumbed much more quickly, and the mortality among affected animals closely approached 100%, whereas in the western states, the mortality ranged from 20% to 40%.



Robert Koch

However, further investigations proved beyond doubt that the virus recovered in the east differed from that of the western areas, both immunologically and serologically, and from the standpoint of control, must be considered a separate disease agent.

Just prior to the announcement by Giltner that a new type virus has been proved, this virus distinction was demonstrated at our laboratories by a costly and indisputable incident. Soon after the virus isolation was announced from the eastern states, our institution procured it from the Bureau of Animal Industry at Washington, that we might add it to those strains already in use for hyperimmunizing horses in the preparation of hyperimmune sera. Nine horses, which had been immunized for several months, and were producing potent antiviral serum for the western disease, were injected with a dose of tissue virus emulsion, to which was added 10% by volume of the virus emulsion isolated from the eastern disease. Forty-eight hours later, eight of the nine horses injected were dead, and the eastern type virus was recovered from the brains. The only surviving horse was immediately tested and found to be immune to the eastern virus. Just two weeks following this experience, Giltner announced his findings, offering proof that the two viruses were immunologically and serologically different, which was later confirmed by many other workers.

It was indeed difficult to concede that a disease presenting almost identical clinical manifestations should be caused by two distinct viruses. This finding, however, has stimulated investigators to further study in the effort to determine the possible existence of additional viruses, and especially to gather evidence of their territorial distribution. To date, with almost constant vigilance on the part of investigators, and the various state and federal authorities, our information indicates the disease in this country is limited to the two viruses. Also, the Appalachian Mountains apparently still remain the territorial dividing line. It should be kept in mind, however, that the history of disease boundary lines indicates they never remain stationary indefinitely. We already have evidence that the western disease is extending eastward to new states, and in some of the borderline areas, both viruses have been identified. Thus, the problem of control is complicated.

Finally, it should be emphasized that the scope of immunology offers to the future of preventive medicine a most encouraging outlook for the control of many of our infectious transmissible diseases with which, to date, we have been unable to cope. The science of immunology has never stood still; advance has been continuous. Never before have so many capable workers been engaged solely in research problems concerned with preventive medicine in both the human and veterinary field, particularly in the field of virus disease control. From such a concentrated effort, we may expect not only more rapid progress in the development of control measures for new diseases, for which we have nothing at present to offer, but also continuous improvement in existing methods.

In view of expected progress, let us as veterinarians keep an open mind in our judgment of new products introduced from reliable sources and based upon sound and adequate experimental evidence. In brief, let us be critical but progressive.

The Control of Bang's Disease by Slaughter

By W. L. WILLIAMS,
Ithaca, New York

WHEN a disease of domestic animals attributed to contagion defies all other attempts at suppression, slaughter of the affected and dangerously exposed animals is naturally brought forward for consideration. Before entering upon a discussion of slaughter as a control measure for Bang's disease it is well to glance briefly over the history of other efforts at control.

Fleming[1] recorded an epizootic abortion in cows in Rome 278 B. C. which threatened the extinction of cattle. Later, serious outbreaks of abortion were recorded in various countries. Toward the close of the eighteenth century some came to believe in a contagious or infectious abortion— an infectious death and expulsion of the fetus. It was well known that much abortion occurred in foot-and-mouth disease and other maladies, but this was regarded simply as a complication of the general malady, while contagious abortion was a female complaint in which the expulsion of a fetal cadaver was the sole direct phenomenon. There was no unanimity of opinion. So Fleming[2] in 1877 was not at all certain that there existed a contagious abortion. With the advances in domestication, the crowding of cattle together, and the disadvantages they encountered through forced breeding and milking and by artificial feeding and handling, diseases interfering with reproduction grew parallel with dairy husbandry, and the conception of contagious abortion became fixed.

Naturally there was a diligent search for a remedy; and, long before the noted discovery by the illustrious Prof. Bang, there were numerous sure cures for cattle abortion. When the science of bacteriology became established, there was a prompt effort to control abortion with disinfectants. Brauer[3] advocated the internal administration of carbolic acid—a systemic disinfection. Highly favorable results were recorded but failed to stand the test of time. Others (among them I) advocated topical disinfection of the genital tract. However, it slowly dawned upon the profession that any disinfectant of sufficient power to kill bacteria in the uterus also killed the uterine epithelium, and that plan was abandoned. Others for a time advocated the disinfection of the stables (which the diseased cows could immediately reinfect), the burying or burning of fetal cadavers, etc., etc.; but abortion moved on.

■ When Prof. Bang made his great discovery, he concluded that now that the cause of abortion was known, it could be controlled by artificial immunization or, that failing, by quarantine. The conclusion was commendable at that epoch. He failed, however, to recognize that no chronic disease has yet been controlled by quarantine, a good example being leprosy, which has been fought by quarantine for some 4,000 to 5,000 years with no definite success.

Neither has any chronic infectious disease been controlled by artificial immunization in such pronounced manner that this method has been generally accepted. Some claim successful immunization in bovine tuberculosis, but more deny it. It seems illogical to expect successful artificial immunization in a disease in which natural infection does not lead ultimately to immunity if the individual survives. Artificial immunization against abortion has been attempted in numerous ways, four of which may serve to illustrate.

1. Killed bacilli (bacterins) administered to pregnant animals. Vendors of alleged abortion cures recorded many successes for a few years, but their value was largely

[1] Fleming, George, 1871. *Animal Plagues.*
[2] Fleming, George, 1877. *Veterinary Obstetrics.*
[3] Brauer, Carl, 1889. Ueber das epizootische Verkalben nebst neuer durch viele versuchte erprobte Behandlungsweise. *Zeit. für Tiermed.* XIV, 95.

denied and the method virtually abandoned within a decade. Thus Reichel,[4] who was engaged in the sale of abortion remedies, reported in 1912 highly gratifying success and I[5] at the same meeting reported the use of bacterins followed by disastrous abortion, following this later with a more extended study of the group constituting Table I in *Diseases of the Genital Organs of Domestic Animals*. Both reports were doubtless correct as to the facts related, but led inevitably to directly opposite conclusions. Reichel was reporting upon heifers not destined to abort and the bacterins did not *cause* abortion; I was dealing with heifers doomed to abort and the bacterins did not prevent it.

2. The vaccination of non-pregnant cows with virulent living bacilli. Bland[6] reported the vaccination of 600 cows and heifers, with 416 controls, with an incidence of 4.8% abortions in the vaccinated animals and 19.7% in the controls — an excellent showing. But he failed to state what he meant by abortion or upon what basis the controls were selected; and when the data are closely studied, it is seen that 21.3% of the vaccinated failed to produce calves, as compared with 24.7% of the controls—a reproductive difference of 3.4%. According to the report, all cows which did not abort calved correctly, from which the reader is to assume that there were no abbreviated pregnancies, no calves born dead, no dystocia, no retained afterbirth, no milk fever, etc.! No clinician of experience can accept such a statement, although Bland was doubtless sincere. So with other available reports; the experimenters fail to record essential data and lead the reader to erroneous conclusions.

3. In a lesser degree the vaccination of pregnant cattle with living virulent bacteria has been advocated, but this has attained no great degree of support. Bland[6] inadvertently vaccinated some pregnant animals and was surprised to find that all calved correctly, whereas 4.8% of animals vaccinated when non-pregnant aborted.

With few exceptions, breeders and veterinarians have become well convinced by experience that vaccination with virulent cultures of *Br. abortus* is at best worthless. By selecting data the results may be made to appear highly convincing *for* or *against* the plan. Thus Moore and Fitch[7] authentically related that five pregnant cows receiving *Br. abortus* cultures intravenously aborted promptly; at the same time, five pregnant heifers in my department received the same dose, although only one-half the body weight, and none aborted. One might conclude that a standard dose causes uniform abortion, while double the quantity per body weight *prevents* abor-

During the more than 40 years since the famous discovery by Professor Bang, an innumerable array of cures for Bang's disease have been announced. They have included antiseptics given internally; topical disinfection of the genital organs; disinfection of the stable floors and other objects; incineration of the fetal cadaver and its membranes; vaccination with dead cultures; vaccination of non-pregnant and pregnant cattle with live, virulent bacilli; vaccination of calves with feebly virulent bacilli; the administration of vitamins and endocrines; artificial insemination. Federal and state veterinarians, veterinarians in veterinary and agricultural colleges, and vendors of abortion nostrums have flooded the country with abortion bulletins, but Bang's disease continues to flourish. Many of the proposed remedies looked good, but one after another has fallen under the test of experience and time. Losses from Bang's disease being upon the ascendant, the killing of all infected animals has been brought forward as the sole and only remaining hope.

[4] Reichel, John, 1912. Contagious abortion bacillus vaccine. Ann. Rep. U. S. L. S. S. A., p. 105.

[5] Williams, W. L., 1912. Ann. Rep. U. S. L. S. S. A.

[6] Bland, G. R., 1911-1916. Epizootic abortion experiments. Oxfordshire County Council Education Committee (England).

[7] Moore, V. A., and C. P. Fitch, 1912-13. Ann. Rep. N. Y. State Vet. Col., p. 82.

tion; but such a conclusion would be heavy to carry.*

For a time some vendors of abortion vaccines, prominent in the veterinary profession, advertised them on the basis of no cure-no pay, and in a current periodical I still find advertised government-approved vaccines, with satisfaction guaranteed.

4. Calfhood vaccination with feebly virulent vaccines has recently been hailed as a great success and the published reports are as optimistic as were the earlier claims for bacterins and for virulent vaccines. The data in all available reports are incomplete in numerous vital aspects and he who draws conclusions needs beware. The character of the calves vaccinated and those used as controls is not fully or adequately recorded; the method of breeding and handling is not stated, and the reader is left at the mercy of the experimenter for conclusions. It is not known that the vaccinated animals would have aborted if unvaccinated. The data are no more complete and the results no more attractive than those of Brauer[8] and his followers from the use of carbolic acid. For example, Butler[8] stated: "Calfhood vaccination, when confined to the vaccinating of calves between four and eight months of age, with the vaccine prepared from a virus of low virulency, in our coöperative work has proved a safe procedure." Certainly! When healthy calves are given a small dose of low virulency there is no known reason why it should cause disease. That is true of all known diseases. If the dose and the virulence fall below the resistance of the individual, of course no disease follows. Butler refrained from stating how many calves he vaccinated, what ratio of them could logically have been expected to abort without vaccination, or the breeding efficiency after vaccination. Calfhood vaccination is generally regarded as in the experimental stage.

■ Vitamins have been enthusiastically advocated by a few eminent writers. Most of us admit, especially those of us who would not know a vitamin if it were placed within an inch of our nose, that vitamins are essential constituents of food. What is not so easy to understand is, why a healthy cow should be unable to secure adequate vitamins from good food by the ancient process of digestion of the same grain or other vegetation from which the chemist extracts them at considerable cost.

Endocrines have been highly lauded by some as being effective against abortion. Thus Way[9] presented evidence designed to convince his readers that endocrines, which he was energetically offering for sale, would augment reproduction, with such emphasis that anti-endocrines would soon be needed to prevent overstocking. But Way did not state what endocrines he advised, from what source they were obtained, or what quantity should be given. They were secretly obtained and he marketed them under a proprietary name. It cannot be denied that endocrines are vitally important, but as with vitamins, it has not yet been made clear why a healthy cow with the normal complement of ductless glands must have endocrines extracted from the ductless glands of a mule in order to produce a healthy calf.

Recently there has been an enthusiastic flood of propaganda advocating artificial insemination as a means for the control of abortion. The process has been known to cause abortion, but just how it may be made to prevent it has not yet been made clear.

■ In 1917 I was sufficiently indiscreet to prepare a little bulletin[10] of an extremely crude type which was in sharp conflict with all the foregoing plans. In the above resumé all has been *artificial*—artificial destruction of the bacteria by disinfection; artificial immunization with killed or living bacteria; artificial supplying of vitamins;

* The vaccine used in this causes-prevents experiment was fresh from the college bacteriological laboratory and doubtless reliable. Such, however, is not always the case. Some years ago I obtained, *incognito*, vaccines from the leading vendors and the laboratory reported 75% of the *living* vaccines lifeless.

[8] Butler, W. J., 1934-38. Rept. Mont. Livestock San. Board.

[9] Way, Cassius, 1924. Functional disorders and their possible relation to breeding efficiency. *Cor. Vet.* XIV, p. 175.

[10] Williams, W. L., 1918. Contagious abortion of cattle. Cornell Reading Course for the Farm, Lesson 131.

artificial administration of endocrines; artificial insemination. In the midst of all this artificiality I advised, in very undiplomatic terms, that Bang's disease should be largely controlled by the *natural* process of raising the resistance of the animals through conservative breeding, feeding, and handling.

Queer that I should not have realized this would raise a rumpus! The general attitude regarding contagious diseases is that they may be controlled only by keeping the contagion and the individual apart, or by artificial immunization. Yet, as I tried to point out, everybody knows that in virtually all contagious diseases some individuals fail to become diseased. In one herd 1% to 5% of the cows may react to the agglutination test for Bang's disease, in another, 80% to 100%. In the one the power of resistance is high; in the other, low. Or, if one prefers, the virulence of the organism is low in the former and high in the latter. Naturally the injection of such a view into this mess of uncertainty could not fail to arouse antagonism.

So at the 1918 meeting of the American Veterinary Medical Association, Schroeder, speaking for the Bureau of Animal Industry of the United States Department of Agriculture, virulently denounced my little publication. He was immediately followed by Eichhorn, then an outstanding vendor of abortion bacterins, who moved the creation of a committee on contagious abortion, whose duty it would be to see that the truth about contagious abortion be preserved and to present reports on the subject to which the members could agree. If anyone in the meeting shared my views, they discreetly remained silent, the motion was carried unanimously, and the insignificant little publication was squelched.

Eichhorn's committee had barely entered upon its distinguished career, when I again crossed the path of the Schroeder-Eichhorn group by stating, in the first edition (1921) of *Diseases of the Genital Organs of Domestic Animals*, that the sire was an important cause of abortion. Of course this was unendurable! So the committee, of which Schroeder was a member and Fitch chairman, deemed it essential in its 1922 report, to blast to smithereens this heretical reflection upon the male and preserve the scientific(?) faith in the pure femininity of contagious abortion. Accordingly the committee reported that it was perfectly safe and hygienic to use a bull suffering from severe genital disease, *provided that he copulate only on neutral ground and that the cow should not lick her vulva until all waste semen had been expelled.* This brilliant declaration was unanimously adopted by the American Veterinary Medical Association as a preëminently scientific article of faith, which remains to this day as the official opinion of this big association.

The details for the application of this brilliant idea are not clearly recorded. Possibly Eichhorn's committee meant that in a beef herd on the open range, consisting of 5,000 to 10,000 breeding cows and 100 to 500 bulls, and ranging over 50 to 100 square miles of rough terrain, billboards would be erected every mile or two, on which were plainly inscribed, in the bovine tongue, warnings to all genitally diseased bulls to copulate only upon neutral ground upon penalty of having their tails twisted; and commanding each cow which has copulated with a genitally diseased bull to refrain from licking her vulva until one hour after sunrise the next morning or be branded as an immodest female.

Every effort should be made to devise a more scientific method for controlling and eradicating Bang's disease than blood testing, segregation and slaughter. Experience has proved that proper herd management, together with calfhood vaccination, is a desirable method of control and ultimate eradication of Bang's disease under range and semi-range conditions.—*John R. Mohler, D. E. Westmoreland, R. W. Smith, H. R. Smith,* and *W. J. Butler* in Report of Com. on Policy, U. S. L. S. S. A.

There could hardly be a greater misnomer than to call the federal-state Bang's disease control project voluntary. It possesses the optional aspects of military discipline, of which it has been said: "You can't make a soldier do anything, but you can make him wish he had." The breeder is not forced to accept the plan. He can quit selling his animals across state lines, cease showing them at fairs, and go out of business. The dairyman supplying milk to cities requiring the test is at liberty to slaughter his herd and go on relief without the formality of signing the coöperative agreement.

■ No one of the first six plans outlined having been generally accepted, and the seventh proposal having been contemptuously rejected, the killing of the infected animals inevitably came to the fore, and in 1934 the Bureau of Animal Industry of the United States Department of Agriculture, in coöperation with the various states, began an intensive warfare against Bang's disease by the slaughter of all animals positive to the agglutination test, and this has become the one, officially endorsed, plan for combating the malady.

The effort to control Bang's disease by slaughter has now been in force almost six years. The reports concerning the progress attained are highly encouraging when read superficially. When it is desired to go more deeply into them and make an authentic analysis, it is found that the data are inadequate.

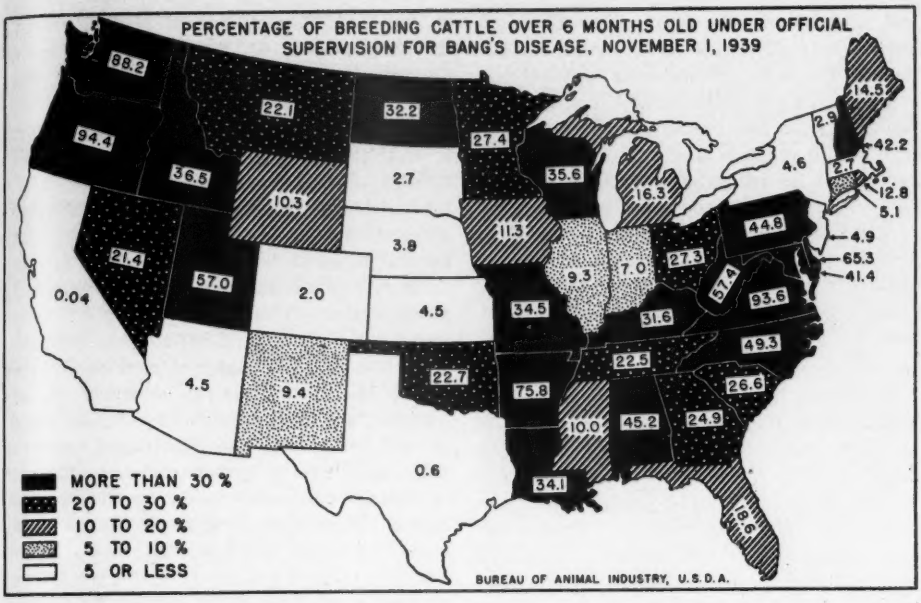
The plan is said to be *voluntary*, but the meaning of that term is not always clear. The coöperating states make various laws. Thus in some states, if an owner has his herd privately tested the results must be made public and the reacting cattle killed or quarantined, without indemnity. If the owner does not test his animals and therefore does not know that they have Bang's disease, he is not transgressing the law; but the moment he learns that some of his cattle react, he is penalized by quarantine, slaughter of the reactors or otherwise. If a breeder wishes to sell cattle into another state, he is required to show that they are free from Bang's disease; but once they cross the interstate line they are free to enter a herd of reactors. The breeder of pedigreed cattle may not enter them in a state fair unless they are shown to be negative to the test; but they are permitted to abort while at the fair and to react when they return to the farm.

The most impressive feature of the reports is a series of maps of the United States in which, at intervals, the ratio of cattle under federal-state control in each state is shown. The ratio of cattle under control is indicated by black and white. Those states having 30% or more under control are indicated by solid black, and those of less than 5% by blank white.

■ The two major reasons for control of Bang's disease are public health (undulant fever) and agricultural economics.

The control of Bang's disease in cattle as a human health problem is fundamentally aimed at the peril from the consumption of contaminated fluid milk. This particular danger may be overcome by pasteurization. Neither pasteurization of milk nor slaughter of Bang-positive cows, however, can cancel the danger of undulant fever. All domestic, and numerous wild

Just to aid the cattle owner in deciding whether to voluntarily "sign up" for the Bang's disease project, Arkansas has invoked the old tick law for his destruction; various states have enacted compulsory area testing statutes; Indians, always great sanitarians, have refused permits for grazing on their lands; bull rings have withheld membership, and county agents have declaimed about "patriotic duty," etc., *ad nauseam*.



animals are carriers of the bacillus. Numerous cases of undulant fever are attributed to contact with swine, sheep and goats. One of the most extensive outbreaks of undulant fever in America was not attributed to the use of contaminated fluid milk nor to contact with animals, but appeared in the bacteriological laboratory of a veterinary school.

The highest incidence of genital pathology, including Bang's disease, occurs in large dairy herds, maintained under high pressure of breeding, feeding and handling for the production of the maximum quantity of milk to be sold as fluid milk in metropolitan areas. In the accompanying map, four states east of the Mississippi River: New York, Vermont, Massachusetts and New Jersey, are shown to have less than 5% of their cows under Bang's disease control. Breeders of purebred cattle are, in effect, placing their herds under control only if they desire to sell breeding stock into other states or to show their cattle at fairs. Agricultural schools, corrective and charitable institutions place their herds under control as matters of policy.

The four states mentioned are preëminently industrial and consume vast quantities of fluid milk. New York City[11] procured in 1938 from these four states 82.7% of its fluid milk and Boston 71.1%. Other important industrial centers within these states certainly obtain virtually all their fluid milk from their home states. It would be absurd to claim that the federal-state control of Bang's disease lessens perceptibly the peril from undulant fever in these states. Many, if not most, boards of health have concluded that under present conditions, fluid milk is unsafe and pasteurization is required.

Economically the situation is not more brilliant. Dairymen in the four states mentioned complain bitterly of financial distress. No states in the Union, and probably no state in the world has greater economic need for the control of the genital diseases of cattle, but thus far, neither slaughter nor any other plan has yielded acceptable results.

Official reports upon the control of Bang's disease may appear highly favorable superficially and yet be grossly misleading, without any misstatement of fact. Thus in the U. S. Department of Agriculture report of Sept. 15, 1936, among 72,448 cattle, there was 27.6% of reactors in the

[11] Agricultural Statistics, 1939. U. S. Dept. of Agr.

first, and 2.7% in the fourth test. The first test unavoidably involved an accumulation of reactors, some dating back indefinitely, possibly 5 to 10 years. In a herd of 20 animals, with five reactors, all five (25%) may be old reactors and the other 15 may have been in intimate contact with them for several years. There is no evidence that, had the five reactors remained in the herd for another year or two, any of the 15 negatives would have become positive, yet readers of the report are likely to think that the slaughter had reduced the *spread* of the infection from 25% to zero.

Numerous herds remained infected, the losses from slaughter were ruinous and many dairymen abandoned the plan, while those herds with a low ratio of reactors continued it. Again the report may show a highly gratifying decrease in Bang's disease when, in fact, no important decrease has occurred. Thus Butler[8] reported that among 136,687 dairy cows tested during 1936, 6.6% were positive and slaughtered, while two years later 72,664 cows yielded 3.5% reactors. There was a reduction of 47% in the number of cows. The dairymen had the option of test-and-slaughter and the pasteurization of milk. Logically, the most extensive herds, where normally genital diseases are most severe, found pasteurization far more economical than slaughter; and an apparently significant decrease in the ratio of positives inevitably resulted, without any actual betterment.

The slaughter of reactors often means bankruptcy to the dairyman. Thus Wing[12] lists Glista Ernestine as the fourth greatest cow of history, with 13 calves, seven of which were females of high production. At her zenith she was positive to the agglutination test for Bang's disease at a dilution of 1:500. She may have been thus positive for six to 12 years. It was not learned that she was a carrier of *Brucella abortus* at any period of her life. So in the Connecticut state herd at Storrs, by far the best milker and breeder in the herd was a reactor throughout a number of years. The phenomenon is common, the best cow in the herd being permanently positive.

[12] Wing, H. H., 1928. Bull. 376, Cor. Univ. Agr. Exp. Sta.

■ The U. S. Department of Agriculture in its news release of 1939[11] presented data from a selected group of states—Ohio, Indiana, Illinois, Michigan, and Wisconsin—and thus gave a radically different picture from that which would have followed a discussion of the results in New York, Vermont, Massachusetts, and New Jersey. There is far greater need for the control of genital diseases in the latter than in the former group, both from public health and from economic standpoints. Using for comparison New York and Wisconsin: the former has 43 cattle per square mile; the latter 39.4. Wisconsin is a highly fertile agricultural state; New York has vast areas of non-fertile soil and of hills and mountains which have been denuded of forests, carelessly cultivated and the fertile soil wasted by erosion. New York cannot grow sufficient grain and hay to feed its cattle but must purchase most of its grain and protein food and much of its hay from the Mississippi Valley. It therefore buys heavily of concentrated protein foods, largely processed, like cottonseed or linseed cake, which are not natural cattle foods. Wisconsin dairymen can readily grow all grain and hay needed and provide an abundance of natural cattle foods, to which they may add concentrates and processed foods where desired.

Dairying has different objectives in the two states. Wisconsin has a total of 53% more cows than New York, but fewer cows per square mile. New York produces 16,891,000 pounds of butter annually, while Wisconsin produces 175,659,000 pounds, a superiority of 939%. New York makes 29,642,000 pounds of cheese annually, while Wisconsin produces 243,003,000 pounds, an increase of 723%.

The marketing of fluid milk calls for the production of a uniform quantity throughout the year. The price of fluid milk is highest and the cost of labor lowest in winter. Consequently New York cows are largely bred to calve during October, November, and December. The vigor of the cows is much depressed. The fate of the calves is far worse. Deprived of sunlight and fresh air and badly fed, there is great

mortality from calf scours and pneumonia. The survivors are largely anemic, pot-bellied and destitute of vigor until at least six months of age, when ovulation and spermatogenesis become established and the quality of sexual development has become fixed for life. A brief nine months elapses and the half-grown heifer is bred, with great probability that she will abort, calve at less than 280 days, "give birth to a dead calf," suffer from dystocia, retained afterbirth, metritis, or other pathological phenomena.

The problem facing Wisconsin dairymen is very different. Butter and cheese do not have to go on the market immediately. The cows may be bred when in maximum vigor while at pasture in early summer, and the calves may be born at the natural season in spring and have access to succulent grass. Accordingly there is produced in Wisconsin a surplus of highly efficient dairy cows, while in New York there is a regrettable deficit. Wisconsin dairymen annually sell to New York dairymen vast numbers of healthy young dairy cows to replace those discarded from genital disease. New York requires that the cows entering from Wisconsin shall be negative to the test for Bang's disease. After these Bang's-disease-free cows have crossed the state line they are eligible to enter any New York herd, regardless of its state of health and, after a fitful year or two, to follow their predecessors to the shambles or to the rendering establishments. Wisconsin dairymen may well afford Bang-free herds. Any loss sustained by the slaughter of reactors is more than made good by the increased price the New York dairymen pay for the Bang-negative cows they buy. So Wisconsin shows 35.6% and New York 4.6% under federal-state control—a showing just the reverse of the relative public health and economic needs for the control of genital disease in cattle.

■ California, with 0.04% under control, is the lowest in the United States. The reason is not clearly revealed. It has 14.2 cattle per square mile, less than 30% of which are dairy cows. With one-half as many cows as New York, California makes four times as much cheese and less than one-third as much butter. In the fluid milk areas about Los Angeles and San Francisco, the losses from genital disease are unofficially reported as enormous. Possibly the small interest in the test and slaughter project in California is explained by some reports of the highly successful experiments with calfhood vaccination that have emanated from that state.

This cow was a Bang's disease reactor in an otherwise negative herd for 12 consecutive years following her purchase as a three-year-old. During that time she produced 12 normal calves and some 160,000 pounds of milk containing approximately 6,000 pounds butter fat. (*Vet. Med.* 34:7, p. 456.)

Six other western states — Arizona, Texas, Colorado, South Dakota, Nebraska, and Kansas—have less than 5% of their cattle under the control plan. These six states contain 25% of the cattle in the 48 states. There are no great fluid milk markets. The vast majority are range beef cattle.

The prevalence of Bang's disease in commercial range beef herds is unknown. The phenomenon of abortion in such herds is not great. In one and one-half years as

resident veterinarian where 5,000 Hereford calves were produced annually I observed no case of abortion as commonly defined—I saw one case of "dead at birth" with dystocia. Presumably there were disasters which I would have designated abortion had I seen them.

Now and then a veterinary writer glibly states how easy it is for him to apply the rapid agglutination test in range herds. That is undeniable. But I have seen no authentic account of the cost to the breeder. I heard a story when a boy, regarding a fabulous flea powder of high efficiency. The directions were to be found inside the package and were consecutively numbered:

"1. Catch the flea."

Similar philosophy applies to testing range beef cattle. When it is desired to round up 500 to 1000 beef cows and calves ranging over 100 square miles of rough terrain, ten or more highly trained cattlemen, mounted on highly trained horses, are required and the drive consumes much of a day. There is inevitably some chasing of nervous animals, and the fewer the mounted men, the more chasing. They are then milled around for the rest of the day without food or water, with resulting physical injuries to cattle, men and mounts. There is an inevitable cost of serious proportions which we have no means of estimating except for the cost of the men and their mounts. The cost of repeated rounding up of range herds of 5,000 to 25,000 or over would be appalling and would interfere with the health and growth of the cattle beyond all endurance. And after all has been done, the ratio of Bang's disease would presumably be trivial, the infected animals would not carry recognizable peril to public health and would be no less valuable for beef, which is their ultimate destiny. Hence the breeders of ranch beef cattle keep as far away as possible from the present control plan.

Washington is the prize state in the cooperative plan with 94.4% under control. The state has 1.2 dairy cattle per square mile compared to New York's 43.

■ In the Farm Flash from the Bureau of Animal Industry of January 25, 1937, it is admitted that in some herds in highly infected areas the infection persisted despite repeated testing. Upon inquiry of the veterinary officials in charge in nine states and 270 herds, 60 different causes of such persistence were reported—for all of which the dairymen were responsible; the veterinarians and the scheme were perfect. One to ten of the causes cited appear in essentially all dairies.

The foremost cause of failure to eliminate Bang's disease from infected herds, according to the bureau, was the purchase of infected cattle for replacements. This is a highly perplexing statement. The veterinary officials are said to explain the plan to the dairymen, who enter into a contract not to introduce infected animals. A dairyman who would send to slaughter half of his best cows because positive to the agglutination test would be a pitiable fool to deliberately or carelessly bring in an equal number of infected cows to replace those slaughtered. Explicit proof of instances of such folly are omitted. The veterinary officials should, under the contract with the dairymen, control the source of replacements; and they, not the dairymen, should be responsible for the health of the new animals. Instead the Bureau charges the dairymen with a want of intelligence or something worse.

It is quite unnecessary to introduce a positive reactor into a negative herd in order to have plenty of Bang's disease. This is well illustrated by Thorpe and Graham,[13] who relate that a herd under their observation, having been negative for several years, suddenly became positive to the Bang's disease test, leading to the slaughter of the entire herd. No cattle had been introduced except a negative bull from a Bang-free herd. In their search for the source they tested the horses, swine, and pigeons of the farm. Apparently they forgot that veterinarians occasionally react to the agglutination test and failed to apply the tests to Thorpe and Graham.

Throughout the reports upon the federal-state control of the disease there is ref-

[13] Thorp, Frank, Jr., and Robert Graham, 1933. The rapid spread of Bang's disease in an accredited herd. *J. A. V. M. A.* XXXII, p. 749.

erence, generally vague and impossible to follow, concerning the withdrawal of herds from the plan after one or more tests. The one quite definite statement found is by Busman of Indiana[14] who stated that 75% of the herds dropped out after the initial tests. This apparently indicates why Indiana has but 7% under control. The owners find the plan leading directly to financial ruin and break their contracts.

The next most important cause named was the intensity of the infection. This sounds strange. In the herd described by Thorpe and Graham, the disease was easily and promptly eliminated by slaughtering the entire herd. A colleague of high ability related to me personally the case of a herd of about 40 cows entered for control. Half of them were pregnant—and positive; the other half were essentially all sterile. The positive animals were slaughtered, and contagious abortion was eliminated at a single stroke! So was the dairyman, as a dairyman. Of course the case was not officially published. Henderson[15] reported upon the breeding efficiency of a large herd, evidently that of an unidentified agricultural college, since six breeds of pedigreed dairy cows were included. It is also clear that a prior herd had been wiped out because of Bang's disease, and new cattle purchased. That was easy and effective. Happily also it cost the slaughterers nothing—the new herd was purchased with public funds. True, there were slight drawbacks. Abortion, sterility, retained afterbirth, etc. were still abundant and some animals reacted to the agglutination test. Most conspicuous was the fact that several bulls and numerous cows were ruined by trichomonad disease. How much happier the management was to have Siam's malady instead of Bang's disease is not stated.

■ One of the greatest obstacles encountered in efforts to control the genital diseases of domestic animals is the absence of adequate clinical data. Reports upon private herds are necessarily silent regarding identity and with this repression go many data vital to a complete understanding. The same attitude is pursued regarding the herds in agricultural colleges and under public ownership generally. If Henderson had frankly and fully reported upon the herd which had been destroyed in order to rid it of Bang's disease, stating the number and potential value of the slaughtered animals, what efforts had been made to control the disease without slaughter and any known reasons for those failures, the knowledge would have been extremely valuable. It would have been of equal value to record the source of the cattle purchased, their cost, the origin of the trichomonad disease, the cause or causes of the abundant abortions not attributed to Bang's disease, a clearer, more detailed account of the breeding efficiency of the new herd, etc. But ere he could do this he would be obliged to grossly transgress custom: there is not available, so far as I know, such a report upon the dairy herd of any one of the more than 48 state agricultural colleges, most of which have existed more than 50 years. Ostensibly their purpose is to obtain and publish information regarding the maintenance of dairying efficiency, which is impossible without health. Instead their emphasis is placed upon the record for a month or year of the milk or butterfat production of one cow, though two or three other cows may be ruined in the process.

The information available on genital disease of cattle suffers not nearly so much from lack of experimental research as from lack of clinical observation and dependable records of ordinary breeding operations. The authorities and research workers appear not to realize that careful observation of breeding operations of college and selected commercial herds would give them far more information than they have so far developed from controlled experiments, which because of their cost must be limited to small groups of animals for short periods.

[14] Busman, H., 1938. Rep. of the Bang's disease conference of North Central States, St. Paul, Minn., p. 11.
[15] Henderson, J. A., 1938. Observations on reproduction and associated conditions in a herd of dairy cattle. *Cor. Vet.* XXVIII, p. 173.

■ It appears that the official plan for the control of Bang's disease, in New York, Vermont, Massachusetts and New Jersey, the most important states in the union from the standpoint of the production and use of fluid milk, is a highly regrettable failure because the slaughter method spells financial ruin in many of the largest dairies; in the six states mentioned which produce beef cattle, the cost of testing transcends by far any known value to the breeder or the public. It is in these two groups that control of reproductive diseases is most vitally important; in the one for the production of adequate fluid milk safe for human use; in the other for the satisfactory supply of wholesome beef. The value of the plan should be measured by the results in these two groups of states. The map clearly and emphatically shows that up to the present it has lamentably failed. Even though this or some other plan should succeed in controlling Bang's disease, or if we add to this the trichomonad disease, satisfactory reproduction would not be attained nor closely approached. In the present state of knowledge a large ratio of abortions and associated phenomena are attributed to *unknown causes*. The symptoms and lesions cannot be distinguished from those of Bang's disease. This being true, it is impossible to say, in the presence of *Br. abortus*, that the unknown cause is not present and acting.

■ During the more than 40 years since Bang's epochal discovery, many remedies have been enthusiastically advocated; and in the propaganda employed, highly favorable, though misleading, data have been recorded; yet one after another they have failed to endure the test of time. The suggestion to raise the resistance of animals through proper breeding, feeding and handling was summarily and emphatically squelched as a rank heresy. But since the other methods have failed, may it not occur soon that veterinarians and animal husbandmen will pause and give thoughtful study to the possible value of the conservative and rational breeding, feeding and handling of domestic animals as the foundation for physiological reproduction?

Fatal Case of Erysipelothrix Infection

Veterinarians throughout the corn belt occasionally handle hogs affected with swine erysipelas and in some parts of that section calls to treat such swine are frequent. Localized infections of *Erysipelothrix rhusiopathiae* on the hands or arms are by no means uncommon among midwest veterinarians. Such infections are looked upon as annoying and painful rather than as dangerous or even serious. Erysipeloid, as the infection in man is called, is regarded generally in this region as an occupational disease of veterinarians. It has long been so regarded in Germany, where for many years swine erysipelas has been one of the two or three most important diseases of swine.

A recent report[1] of a fatal case of erysipelothrix endocarditis in the Boston City Hospital shows that these infections may be more serious than they are usually regarded and the fact that the case was not diagnosed until after a necropsy was held indicates that cardiac complications, common in swine, may not be nearly so rare in man as has been supposed. Until the autopsy and a bacterial study were made, this case was diagnosed as "rheumatic heart disease with mitral and aortic stenosis and insufficiency."

But two other such cases are recorded in medical literature—one of them in an Austrian veterinarian. These cases likewise were not diagnosed ante mortem. In all three there were abundant vegetative growths on the aortic valves similar to the cardiac lesion common in affected swine, and in the Boston case, which was in a lobster fisherman, there were abscess cavities in the subepicardial fat and in the myocardium.

Local Erysipelothrix infections, which a considerable number of veterinarians have suffered, have responded promptly to the injection of swine erysipelas serum. The fatal Boston case survived for two months after the beginning of the attack and apparently if a correct diagnosis had been made promptly and serum administered recovery might have been expected.

[1] Russell, W. O., and Marion Lamb, 1940. Erysipelothrix endocarditis; a complication of erysipeloid. *Jnl. A. M. A.* 114:12, pp. 1045-50.

Recent Materia Medica

V. Vitamin B_1 (Thiamin Chloride)

By PROF. VICTOR LEWITUS,
Nutley, New Jersey

History

AS EARLY as 2000 B.C. the Chinese recorded a disease marked by wasting and paralysis which we today recognize as beriberi. Not until the pioneering observations of Eijkman as late as 1897, however, did the world suspect any connection with a missing factor in the diet. It was only after this Dutch scientist, stationed on the fertile island of Java, noticed that chickens became sick when they were fed on polished rice that his suspicions were first aroused. He rightly concluded that certain ingredients, which were indispensable to the animals' normal subsistence, were removed from rice by polishing. Grijns, in 1901, substantiated these findings, and shortly thereafter biochemists set out to learn the nature of this vital substance. Attempting to isolate this very factor, Funk (1911) postulated his "vitamine" theory and predicted the existence of four of the essential vitamins, amongst which was the "antiberiberi vitamin." This antineuritic substance was assumed to be a single nutritive principle, designated vitamin B, but Smith and Hendrick, in 1926, separated the heat-labile factor (now known as vitamin B_1) from the heat-stable factor (vitamin B_2 or G). In the same year, Jansen and Donath first isolated the substance in crystalline form, but it was not until 1936 that Windaus in Europe, and Williams and Kline in America announced independently the actual synthesis of this complex vitamin. It is doubtful whether the isolation, identification, and final synthesis of any other substance in biochemical history involved as many men or consumed as much time or energy as has been expended in making vitamin B_1 available in abundant quantities.

It is interesting to note that vitamin B_1 has lately been introduced into horticultural work as a "plant hormone" to stimulate rapid rooting of cuttings, hasten growth, cause earlier seed germination, increase the number of blooms, etc. Though this effect is not common to all plant species, so many appear to be favorably influenced that a trial seems worthwhile. There is evidence, however, that overdosage of the vitamin can do harm, so that it must be properly diluted (100mg to 2000 gallons) and used only according to directions.

Sources

Vitamin B_1 is found, along with other members of the B-complex, in yeast, wheat germ, whole grains or cereals (whole rice, whole wheat, etc.), legumes, most fruits, nuts, milk, egg yolk, and organ and muscle meats (liver, kidneys, heart, etc., and particularly in pork muscle). A great many medicinal preparations on the market contain the synthetic vitamin B_1 (thiamin chloride). Most natural sources contain relatively small amounts.

Chemistry and Properties

Synthetic vitamin B_1 is chemically a pyrimidine-thiazole compound known as thiamin chloride. It has the formula $(C_{12}H_{17}N_4S.HCl)Cl$. It is one of the few vitamins that is nitrogenous and contains sulphur. It occurs in the form of colorless, odorless crystals which are very soluble in water, and slightly so in alcohol. The aqueous solutions are acid to litmus (pH about 3.5). The crystals are hygroscopic, and melt at 248-250°C. The substance is stable in acid, but decomposes readily in alkaline solutions; hence in cooking it is often destroyed by the addition of baking powder, or soda. It is not easily oxidized or destroyed by exposure to air or light. Prolonged heating, however, decomposes this vitamin.

Standardization and Assay

Synthetic crystalline vitamin B_1 has just recently been made the reference standard, the substance known now as thiamin chloride being available from the U.S.P. Board

of Trustees. This means that the crystalline substance will be compared with this standard (physically and chemically); but when present in preparations or solution or as part of the vitamin B complex its activity must be determined by certain acceptable biological assay procedures. The recognized standard on a weight basis is:

One gram crystalline thiamin chloride contains 333,000 U.S.P. units (or International units); *i. e.*, 3 gamma (0.003mg) standard crystalline vitamin B_1 has the antineuritic activity of one International or U.S.P. unit.

Incidentally, the older Chase-Sherman unit is approximately equivalent to ½ U.S.P. or I.U.. Various biological assay methods are employed for testing vitamin B_1 preparations or solutions; *e. g.*, the rat-growth, the rat-curative, and the pigeon-curative methods. Briefly, the rat-growth method consists of feeding rats a test diet containing no vitamin B_1 for about two weeks, after which period the animals cease to grow. They are then fed daily doses of the vitamin supplement, and the increase in body weight is compared to that brought about by the standard. In the rat-curative method, endorsed by the U.S.P. Vitamin Advisory Board, young rats are maintained on a specific vitamin B_1-deficient diet until their body stores of the vitamin are depleted as judged by the onset of acute polyneuritis. Such depleted animals are suitable for use in the assay proper, provided the depletion period required to develop the polyneuritis has not exceeded 75 days. Now, to each of these animals is administered a single dose of the reference standard of such size that a curative period of not less than five nor more than 15 days will follow. Each animal is then carefully observed until the exact degree of acute polyneuritis reappears, at which time an appropriate single dose of the material under test is administered. The duration of the cure of polyneuritis is again observed. Only data obtained from successive administration to the same animal of the reference standard and the material under test (using eight rats or more) are considered. The data based on rats in which the duration of cure following the test material is equal to or greater than that produced by the reference standard, are the only ones suitable for establishing potencies. This method appears in the new U.S.P. XI supplement. The pigeon-curative method, popular in Europe, involves the feeding of polished rice to pigeons for two or three weeks until polyneuritis develops. Injections or oral administration of the vitamin preparation being assayed tests the potency for curing the condition.

Jukes and Heitman have recently carried out assays of thiamin with chicks in place of rats. A response curve is constructed on the basis of the level of the thiamin added to the diet, compared with the "polyneuritic mortality index"—the latter expressing the degree of protection afforded by a suboptimal level of thiamin fed during the assay period of 28 days. The thiamin requirement of the chick was estimated as being between 130 and 150 micrograms of thiamin chloride per 100gm of diet for prevention of polyneuritis under the experimental conditions.

Other methods of testing substances for the vitamin B_1 content have been employed, especially for humans, such as the urinary excretion test (bio-assaying the urine) or the blood test, but none of these has been proved dependable.

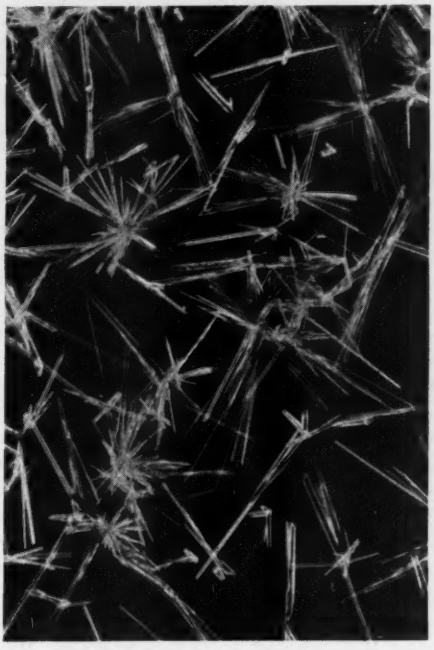
Function of the Vitamin

Extreme deficiencies of thiamin chloride are characterized by some form of polyneuritis or beriberi. This consists of a peripheral neuritis, characterized by motor and sensory incoordination, and in its incipiency by fatigue, depression, stiffness of the extremities, numbness, occasionally edema. The disease in the younger animal varies somewhat in its manifestations from that of the adult. Fatal termination of the syndrome is usually due to progressive cardiac involvement. It might be emphasized, in passing, that deficiency of this type in mammals other than man may be due to deficiency in the mother reflected in her milk; it is also important to note that animals do not store the B-vitamins for any appreciable time. Partial deficiencies of vitamin B_1 are probably more common than is sup-

posed, because the syndrome is not yet readily differentiated. Cowgill has done much work along these lines, and points out that the B_1 requirement of an animal is a function of the body weight regardless of species. For example, in humans, he has established the adult minimum (not optimum) level of 200 I. U. as sufficient to prevent beriberi. It has been shown by Knott that the higher the intake level of the vitamin, the greater its retentiveness in the body. In children, the estimated optimal requirement (found by this authority) is 10 to 20 I. U. (or 40 Chase-Sherman units) per kilogram of body weight. There is undoubtedly a wide range between the minimal and optimal levels.

Growth Promotion.—The significance of vitamin B_1 in growth regulation has already been emphasized under the biological assay procedures. Chick and Roscoe noted the cessation of growth on B_1-deficient diets, and proved it is resumed by furnishing the vitamin to the animals. Not only does the animal not gain weight, on a vitamin B_1-deficient diet, but actual losses are entailed. Gain in weight on vitamin B_1 supplementation signifies that a B_1 shortage existed. This may be due to influences on carbohydrate metabolism, digestive function effects, or both. Dann and Cowgill have observed that for growth, young rats require from three to five times more vitamin B_1 than for maintenance at a certain weight level. It appears that female rats at puberty require decidedly more than other animals of the same species. Likewise, Sure noted higher requirements in lactating female rats than in others.

Gastro-intestinal Functions.—One of the most prominent symptoms of thiamin deficiency is anorexia. This is attributed to decreased gastric secretions which may be corrected in many cases by administration of the vitamin. Experimenting with dogs, Cowgill observed that when vitamin B_1 was denied the animal, loss of appetite was an early symptom and the animal ate irregularly or refused to eat for several days at a time. Following Pavlov's technique, he sampled the gastric contents, and found the secretions inhibited. The inanition which follows may be due to lowered tissue oxidation. The blood appears to be altered more than the digestive secretions, which



Thiamin Chloride Crystals.—*Photo courtesy of Hoffman-La Roche, Inc.*

may account for the metabolic effects. There is a well-recognized gastrointestinal atony due to lessened motility, with subsequent stasis. In many animals, there is an enlargement of the colon far beyond the usual limits due to the extreme lack of muscular tone. This has been observed in radiographs of rats taken by Sparks and Collins, and also Hargreaves *et al.* The latter workers verified their findings by feeding their animals with B_1, which returned them to normal.

Carbohydrate Metabolism.—Vitamin B_1 is definitely concerned with carbohydrate metabolism. The effects are associated in some way with oxidative phenomena. The glucose tolerance is less in animals deprived of vitamin B_1 than in normal animals; and the accumulation of lactic acid in the tissues following a period of activity is much greater in B_1-deficient than in normal ani-

mals. There must, therefore, be some interference with the lactic-acid-glycogen conversion or its oxidation to water and CO_2. In rats, B_1 deficiency often results in bradycardia, probably due to such lactic acid accumulation, for it is promptly cured by supplying the vitamin. Recently, Tauber, Peters, Stern, and others have attempted to clear up the complex mechanism of carbohydrate metabolism and its relationship to vitamin B_1. The theory is briefly as follows: Under the influence of enzymes, lactic acid is converted to pyruvic acid which accumulates in the blood and tissues unless it is removed by catalytic action of another enzyme (carboxylase). Vitamin B_1 (the pyrophosphoric acid ester) is the coenzyme (cocarboxylase) which activates the enzyme carboxylase. Thus pyruvic acid, in the presence of sufficient B_1, is converted to acetic acid and CO_2 or acetaldehyde and CO_2. It happens that when pyruvic acid accumulates in the tissues, lactic acid also accumulates. It is interesting to note that vitamin B_1 causes the disappearance of pyruvic acid (*in vitro*) of brain tissue of polyneuritic pigeons. It seems that tissue oxidation is highly augmented in its presence. It is possible, according to Peters, that the function of the neurons of the subcortical centers is impaired, upsetting tissue metabolism. The explanation of many symptoms of vitamin B_1 deficiency may be found in the disturbed carbohydrate metabolism that usually exists as a concomitant state.

Neuritic Effects.—The most common symptom of vitamin B_1 deficiency in animals is a multiple peripheral neuritis, the lower extremities being involved in humans. At autopsy, this is commonly confirmed by histologic findings. For example, degeneration of the myelin sheath is commonly observed, and the axis cylinders of the neurons at times are found to be atrophied or fragmented. In the spinal cord there are also evidences of degeneration; the posterior columns as well as the spinal nerve roots are often involved. There is also a muscular atrophic condition which is associated with the neuritic symptoms. Gildea and others have reported irregular loss of the myelin of the spinal cord in dogs deprived of vitamin B_1. In the cerebral cortex less evidence of such degeneration was apparent. Zimmerman and Burack have found that in dogs having B_1 deficiency symptoms, extensive myelin destruction of the sciatic, median, ulnar, and vagus nerves, and brachial plexus was evident. According to the work of Vedder and Clark, the marked polyneuritis due to vitamin depletion is the result of destruction of the myelin sheath of peripheral nerves with some fragmentation of the axis cylinders. A similar degeneration of the cord and brain fibrous tracts also occurs.

Cardiac Effects and Edema.—Water retention is commonly recognized as one of the symptoms of the "wet type" of beriberi, but the mechanism of this syndrome and its relation to B_1 deficiency is not clear. In certain cases the edema, in part at least, seems to be dependent on circulatory failure, while in others there appears to be an associated decrease in plasma proteins. Edema is usually found, if at all, only in the presence of extreme depletion. In the human, extreme or even partial deficiencies often involve the cardiac functions, causing tachycardia. This symptom in lower animals is usually not present, but is found as a bradycardia. This symptom is so marked in rats that it has been employed by some as a basis for the quantitative assay of vitamin B_1, since the vitamin promptly relieves the condition. Zoll and Weiss, studying the electrocardiographic changes in rats, have observed that these are similar to those found in human deficiency states. The T-waves are either increased in height, flattened, inverted or show high or low take-off; there is a depression of the S-T segment; and the P-R interval usually remains unaltered. On autopsy the organ often shows great dilatation, but Cowgill's work shows that there is really no hypertrophy in B_1 deficiency. This is proved by an early return of the heart to normal proportions after the vitamin is provided. There is some basis for believing that in extreme B_1 lack the heart becomes edematous, since upon supplementation its diminution is accompanied by marked diuresis. The hearts of normal birds contain much less water than

those of polyneuritic animals. There is much disagreement in respect to cardiac and edematous symptoms in beriberi, for it is difficult to demonstrate histologic changes in the myocardium, in fact, edema is not a constant concomitant sign.

Inadequate lactation.—Evans and Burr, Strauss, and Macy have studied the vitamin B_1 requirements during lactation. In the rat, it has been noted that the maternal requirement is increased from three to five times the normal. Potency of breast milk may be increased by proper feeding of vitamin B_1-rich materials such as yeast, or thiamin chloride itself. Perla and Sandberg have reported a peculiar condition which they attribute to excessive vitamin B_1, in which disturbed lactation and cannibalism due to depletion of the manganese supply was reported. The same workers noted depletion of vitamin B_1 in the presence of excess manganese.

Minz *et al.* have recently tried to elucidate the role of vitamin B_1 in relation to acetylcholine in the body. It appears that the vitamin augments the action of acetylcholine on the cell. The investigators conclude: "vitamin B_1 is identical with the sensitizing substance and acts as a co-enzyme of acetylcholine in the humoral stimulation of the nervous system." This may be the secret of the explanation for the effects of the substance on the nervous system.

Practical Application

In general, the antineuritic vitamin suggests itself in the following conditions in the animal:

1. In the prophylaxis and treatment of certain neuritides:
   - *a* polyneuritis or latent beriberi
   - *b* peripheral neuritis (e. g. following infections)
   - *c* subacute cord degeneration
   - *d* so-called fright-disease
   - *e* certain forms of neuralgia
2. In gastrointestinal disturbances or interference with food utilization such as:
   - *a* anorexia (associated with nutritional deficiency)
   - *b* diarrhea, vomiting, constipation (atonic states)
   - *c* alterations in continuity of alimentary tract (e. g., following surgery)
   - *d* hepatic diseases, jaundice, etc.
   - *e* pancreatic disease
   - *f* nephritic conditions
3. Whenever there is heightened metabolism, e. g. in:
   - *a* febrile conditions
   - *b* infective states
   - *c* hyperthyroidism
4. To counterbalance increased intake of carbohydrates (e. g., during intravenous glucose therapy or increases in the normal diet)
5. In the treatment of obscure cardiac disorders of possible hypovitaminotic origin (e. g., bradycardia)
6. When there is perceptible loss of weight.

According to Quin, herbivorous animals possess the faculty of synthesizing vitamin B_1 by bacterial fermentation in the rumen; hence the B-type of deficiency is seldom a factor in ruminants. He points out that in other species there is often inappetence, paralysis (as in dogs after distemper), polyneuritis of fowls, beriberi-like symptoms in dogs and swine, and faulty carbohydrate metabolism.

In poultry, the deficiency is evidenced by a diminished desire to eat, impairment of secretory and excretory functions, gastrointestinal lesions, emaciation, paralysis marked by leg and wing spasticity and the back of the head pulled back almost touching the spine, finally going into cartwheel convulsions. Toward the end, there is poor vision and failure of proper temperature regulation. Whole grain cereals, wheat middlings, and wheat germ contain plenty of vitamin B_1, so that a high-grade poultry ration containing plenty of germ will usually contain adequate supplies of the vitamin. Chickens require 80 to 100mg per 100 gm of feed.

Morton recently cited an interesting case of a canary suffering from signs of B_1 deficiency. "The bird had stopped singing and gradually became less active . . . when anyone approached the cage, the bird became very excited, fluttered into the corner . . . it was observed to fall to the floor of the

cage, flutter violently, jerk its head straight back, and gasp for air. The diet had consisted of a patented brand of birdseed, inside leaves of lettuce, and fresh water daily. A diagnosis of vitamin B_1 deficiency was made on the basis of the very obvious nervous symptoms, and a history which showed the feeding of polished seeds and inside lettuce leaves, both of which are likely to be low in this vitamin." On proper diet, this bird recovered promptly, showing less nervousness and the ability to sing on the fourth day after commencing the change in diet. In two weeks recovery was complete.

In the case of swine, not much is known as to the vitamin B_1 requirements. Rommel and Vedder, as early as 1915, concluded that pigs are susceptible to beriberi when fed on deficient rations such as polished rice. They believe that the so-called cottonseed poisoning in pigs is probably a nutritional deficiency, and that acute cottonseed poisoning corresponds to wet beriberi and the chronic form to dry beriberi. Posterior paralysis sometimes occurs.

Sheep have been observed to succumb from vitamin B_1 shortages. Pallaske was able to cure certain cases with yeast. The animals fall ill rather suddenly and die in convulsions. Opisthotonos is the most characteristic symptom; autopsy reveals few changes, but histological examination shows lesions indicative of encephalomalacia. Degeneration of the liver has been found in ewes following the onset of neuromuscular symptoms.

In the horse, inanition following the loss of appetite is marked by increased pulse and is succeeded by muscular atrophy due to degeneration and wasting of muscular fiber.

In fur-bearing animals, there is anorexia and decreased food consumption, resulting in undersized animals with smaller, less valuable pelts and, at times, diseased and rough coats. Constipation, inhibited lactation, and polyneuritis may ensue according to the degree of shortage.

Schroeder found gorillas in his zoo affected with a peculiar skin disturbance and loss of appetite. Upon the suggestion that the animals might be suffering from vitamin B_1 deficiency, the B-intake was increased by giving extra amounts of milk, eggs, prunes and yeast. The appetite returned promptly, there was gain in weight, the skin and hair became normal, and the animals became extremely active.

Unlike other species of animals, cows and other ruminants are able to synthesize vitamin B_1 through bacterial symbiosis within their peculiar digestive apparatus. This has been observed by such authorities as Bechdel and others. The animals utilize the vitamin thus synthesized. This is substantiated by the fact that milk from cows on a vitamin-B free diet is only slightly less rich in B_1-content than milk from well-fed animals. Calves appear to have a very low requirement for vitamin B_1, which is not true of the young of most other species.

So much has been written recently regarding vitamin B_1 deficiency in dogs by Patton and others that very little space will be devoted to it here. Loss of appetite, paralysis of the hind legs, vomiting, and foul breath are prominent signs of full-blown deficiency. Partial B_1-avitaminosis is evidenced by anorexia, rough coat, cutaneous edema, muscular tenderness, ataxia, periodic leg weakness, etc. Patton has recently shown the connection between fright disease (canine hysteria) and B_1 deficiency. He found anorexia, restlessness and loss of weight to be early manifestations of induced avitaminosis. Later the dogs became excitable and rushed into dark corners. Nervousness with running and barking fits were prominent signs. A single subcutaneous injection of 500 I. U. of thiamin chloride transformed "a racing, howling maniac, or one in appalling convulsions, frothing at the mouth and screeching piteously, into a quiet though nervous animal within four hours." Patton suggests 500 I. U. as the dose for 12-pound dogs, to be given daily for two or three days, with change of diet to one adequate in vitamin B_1 content.

Although the conditions for which vitamin B_1 will serve well have been indicated here, in part, the required unitage for each of the species needs to be worked out before therapeutic use of the vitamin can be placed on a rational basis.

Useful Prescriptions

No. 5. For Common Skin Ailments

℞ Cotton seed oil.....℥ II
Spirits of turpentine
Kerosene
Flowers of sulphur.....aa....℥ I
Sig. Apply as directed. Shake thoroughly before using.

This preparation is very efficacious in many skin ailments such as common mange and moist eczema in dogs, in cow pox, etc. In fact, the only chronic skin lesions in which it hasn't exerted a beneficial influence has been follicular mange. Even this condition is temporarily improved.

J. T. Alston and Clayton Stephens.
Tupelo, Miss.

No. 6. For Cracked Heels and Irritations About the Legs

℞ Vaseline
Lanolin
Zinc oxide ointment.....aa ℥V
Tr. Iodine .....℥I
Oil of Sassafras.....3III
M. et f. unguent.
Sig. Apply before the horse leaves the stable. When returning from work, wipe off with a clean towel.

This ointment is a favorite among race horses and show horse people. It can be used as a preventive as well as a treatment. Water should not be used in removing the ointment when the horse comes in; or if it must be used, care must be taken to get the heels absolutely dry.—*J. F. D.*

No. 7. For Cracked Heels and Irritations About the Legs

℞ Tr. Iodine.....℥I
Carbolic acid .....℥III
Glycerin q.s. .....ad ℥IV
M.
Sig. Saturate a piece of cotton large enough to cover the area, cover with a sheet of cotton and bandage on. Repeat every day or two.

This is an excellent preparation for chronic scratches. We used to use it when horses' legs became blistered or irritated from the salt thrown on the street in cold weather. It is helpful in almost any leg irritation. J. F. DeVine.
Goshen, N. Y.

No. 8. Sedative Capsule

℞ Chloral hydrate
Po. gum acacia.....aa XVI
M. et f. caps.
Sig. For doctor's use.

Mix the chloral hydrate and the powdered gum acacia together until the chloral is thoroughly coated. The acacia forms a coating over the chloral, which prevents it from dissolving the gelatin, and also is a protective for the mucous membranes when the capsule is dissolved in the stomach. Fill the capsules, sealing by dampening them slightly.

For cattle, give a No. 7 capsule; for horses, a No. 10; for colts, calves or sheep a No. 11 or No. 12. We carry all sizes in our grip.

Excellent in uterine eversion with calcium gluconate and dextrose. Also, in colics, azoturia, forage poisoning, founder and wherever a sedative is indicated, which is most of the time.

E. T. Baker.
Moscow, Idaho.

No. 9. For Catarrhal Bronchitis or Cough in Cats

℞ Ol. oliv
Syrup amygdal .....aa 50.0
M.
Sig. One teaspoonful repeatedly.

No. 10. For Strychnine Poisoning in a Kitten

℞ Chloral Hydrate .....gr. x
Potassium Bromide .....gr. v
Mucilage .....q. s.
Water .....ad ss

E. F. Jardine.
St. Kitts, B. W. I.

No. 11. Emetic for a Cat

℞ Apomorphin. hydrochlor. 0.01
Aq. dest. 25.00
M. et f. sol.
Sig. Inject 5cc subcutaneously.

Effect of Phenothiazine on the Development of Roundworm Larvae in the Feces

By D. A. SHORB, Sc.D., and ROBERT T. HABERMANN, M.S., D.V.M.
Zoological Division, Bureau of Animal Industry[1]
U. S. Department of Agriculture

UNLIKE bacteria and other disease-producing organisms, helminths do not multiply in the bodies of their hosts, as a rule, but reproduce by means of eggs which pass out with the feces. Sheep and other farm animals acquire roundworms (Nematoda) by ingesting infective eggs or larvae. The infective larvae develop from the eggs passed in the hosts' feces. The problem of preventing infestations consists, therefore, in breaking the parasite's life cycle at some vulnerable point.

Among the principal methods employed to accomplish this purpose are anthelmintic treatment and pasture rotation. Anthelmintic treatment seeks to accomplish this desired end by removing the parasites from the host, thereby destroying the source of pasture contamination—the supply of parasite eggs. The success of this method depends upon the efficiency of the anthelmintic used and the degree of regularity with which it is administered.

The aim of pasture rotation is to break the host-parasite relationship by avoiding reinfestation. This is done by moving animals to new pastures from time to time so as to avoid the excessive infestation present on land over which infested animals have grazed for a relatively long time. Pasture rotation depends for its success upon the amount of pasture available and upon a knowledge of the free-living phases of the various parasites infesting farm animals and the environmental factors influencing the persistence of these free-living stages.

One of the chemicals recently described as an effective anthelmintic is phenothiazine. Knipling[2] reported that horn fly larvae did not develop in the manure of cattle to which comparatively small doses of this chemical had been given in the feed over a period of several days. This author further reported that mixing phenothiazine with fresh cattle manure also prevented the development of horn fly larvae in that manure. The result of Knipling's experiments indicated that a sufficiently large amount of the phenothiazine administered to animals in the feed was eliminated in the feces to prevent the development of horn fly larvae. These results, and the later successful use of phenothiazine as an anthelmintic,[3] suggested that when given in small doses, either in capsules or mixed with the feed, phenothiazine might have a deleterious effect on the development of nematode larvae, similar to that obtained in the case of horn fly larvae. A preliminary experiment to test this possibility was undertaken early in 1939, and as the results appeared to be promising, additional experiments were carried out later in that year.

Materials and Methods

Sheep naturally infected with nematodes were used in the tests described in this paper. The worms present in the host animals were determined by fecal examination. The number of worms present in the feces was ascertained by the use of the Stoll egg-counting technic, and the number of larvae present in given amounts of feces was determined by the Baermann technic in the first experiment and by the dilution technic in the others. Cultures were prepared daily by grinding 50gm of feces in a mortar and adding charcoal when neces-

[1] This investigation was conducted in the Zoological Laboratory, Agricultural Research Center, Beltsville, Maryland.

[2] Knipling, E. F. 1938.—Internal treatment of animals with phenothiazine to prevent development of hornfly larvae in the manure. *J. Econ. Entom.*, 31: 315-316.

[3] Harwood, Paul D., Habermann, Robert T. and Jerstad, A. C. 1939.—Efficacy of commercial phenothiazine in the removal of roundworms of sheep. *Vet. Med.*, 34:7, pp. 440-443.

sary. These cultures were kept at room temperature for five to nine days. They were then placed in a glass cylinder, the culture jar washed with water, the washings added to the culture material in the cylinder, and additional water added to make a total volume of 2,000cc. After allowing the material to stand for several minutes, the mixture was stirred thoroughly and a 1cc sample withdrawn; the larvae in the sample were counted in a Scott counting chamber. If no larvae were present in the first sample, additional samples of 5cc were taken until a total of 40cc were examined. If larvae were present in the first sample, three additional samples were counted. Calculations were then made to determine the number of larvae originally present.

TABLE I. THE EFFECT OF THE ADMINISTRATION TO RAM 116 OF SEVEN GRAMS OF PHENOTHIAZINE FOR THREE DAYS IN SUCCESSION ON THE NUMBER OF NEMATODE LARVAE DEVELOPING IN 50-GRAM FECAL CULTURES

Date	Eggs per gram feces	Grams of phenothiazine administered	Number of larvae recovered from cultures				
			1	2	3	4	Average
Jan. 3	*	0	———	145,400	102,180	———	123,740
Jan. 4	*	0	109,900	97,500	109,980	175,680	123,265
Jan. 5	2,200	7	142,400	109,610	77,000	103,200	108,053
Jan. 6	*	7	9,420	17,560	19,050	20,410	16,560
Jan. 7	*	7	0	0	0	0	0
Jan. 8	*	0	0	0	0	0	0
Jan. 9	*	0	0	0	0	0	0
Jan. 10	800	0	7,202	8,904	8,502	4,840	7,867
Jan. 11	*	0	33,524	37,000	40,545	31,175	35,561

* Not determined.

In the first experiment the drug was administered to sheep in capsules; in subsequent experiments it was mixed with the usual grain ration. When given in feed, the phenothiazine was suspended in 10cc of molasses and then mixed with the feed to insure that the total quantity of the drug was consumed. No other feed was given the sheep until the grain was eaten. It was found that the sheep readily ate the mixture if they had been kept on a molasses and grain mixture for a few days before being offered the medicated feed.

Experiment 1

The effects of phenothiazine, at a dose rate of 7gm per day, on the development of nematode larvae in cultures were determined as follows:

Ram No. 116, weighing 125 pounds and passing about 1,500gm of feces per day, was removed from the pasture and placed in a barn. Fecal examination showed this animal to be infested with *Trichostrongylus* spp., *Cooperia* spp., *Strongyloides papillosus, Haemonchus contortus,* and *Oesophagostomum columbianum.* A bag for collecting feces free from urine was placed on this animal January 3. Four 50-gram cultures were made daily from the feces collected in this manner for the duration of the experiment. Seven grams of phenothiazine were given in capsules to this animal January 5, 6, and 7. The results of this test are given in Table I.

It will be noted from Table I that fecal cultures made on the two days preceding the administration of the phenothiazine yielded an average of more than 123,000 larvae per culture, while in those made on the day following the first dose of the drug, the number of larvae dropped to an average of 16,560 per culture. Cultures made on the succeeding three days were negative. Larvae reappeared in cultures made on the third day after the last dose of the drug had been given and increased markedly on the fourth day. Egg counts made on January 5 and January 10 showed 2,200 and 800 eggs per gram, respectively, indicating that the drug in the doses given had some anthelmintic effect, although only one-fifth of the therapeutic dose was used.

Experiment 2

The effect of phenothiazine on the development of nematode larvae in cultures, when the drug was given to infected rams at the rate of one-half gram daily in the feed, was determined as follows:

In this experiment, two sheep, Nos. 199 and 191, weighing respectively 134 and 124 pounds, were used. Each animal was producing slightly over 1,500gm of feces daily when placed on test on October 24 and November 18, respectively. When animal No. 199 was first removed from the pasture, an egg count revealed the presence of 6,800

eggs per gram of feces; this count dropped in the next few days, reaching 3,400 at the time the phenothiazine was added to the feed. A differential count made on one pellet with a direct centrifugal flotation technique showed the following numbers of eggs: *Haemonchus contortus,* 97; *Ostertagia* spp., 3; *Trichostrongylus* spp., 40; *Cooperia* spp. 65; *Bunostomum trigonocephalum,* 4; *Chabertia ovina,* 1; and Strongyloides, many (not counted). The 50-gram culture made on the day the phenothiazine was first fed yielded 122,000 larvae exclusive of Strongyloides, while that made the next day yielded only 50,000, and in the culture made on the following day no larvae were found. Strongyloides larvae, although present in the cultures made at this time, were much reduced in number. During the experimental feeding of phenothiazine, the egg count dropped slightly, probably because of the decrease in the number of worms following the removal of the animal from the pasture rather than the therapeutic effect of the drug. Larvae developed in the feces collected the second day after feeding with phenothiazine was discontinued.

TABLE II. NEMATODE LARVAE RECOVERED FROM 50-GRAM CULTURES OF FECES OF ANIMALS TO WHICH PHENOTHIAZINE HAD BEEN ADMINISTERED IN FEED

Animal No.	Phenothiazine administered, Dates	Phenothiazine administered, Grams	Nematode larvae other than Strongyloides	Strongyloides larvae recovered
	Oct. 28	0	112,000	8,000
	Oct. 31	0.5	122,000	10,000
	Nov. 1	0.5	50 000	8,000
	Nov. 2	0.5	0	2,000
199	Nov. 3	0.5	0	850
	Nov. 4	0.5	0	300
	Nov. 5	0.5	0	0
	Nov. 6	0.5	0	600
	Nov. 7	0	600	1.000
	Nov. 8	0	2,700	1,000
	Nov. 18	0	44,000	10,000
	Nov. 20	0.5	42,000	8,000
	Nov. 21	0.5	40,000	0
	Nov. 22	0.5	0	250
	Nov. 23	0	0	0
	Nov. 24	0.5	800	1,200
	Nov. 25	0.5	0	1,600
191	Nov. 26	0.5	0	0
	Nov. 27	0.5	0	0
	Nov. 28	0.5	0	700
	Nov. 29	0.5	0	400
	Nov. 30	0	0	0
	Dec. 1	0	0	0
	Dec. 2	0	0	1,000
	Dec. 5	0	34.000	0
	Nov. 9	0.25	2,700	1,000
	Nov. 10	0.25	1.,000	1,000
	Nov. 11	0.25	4,800	1,000
	Nov. 12	0.25	300	500
	Nov. 13	0.25	2,200	1.200
	Nov. 14	0.25	3,200	1,000
199	Nov. 15	0.25	0	0
	Nov. 16	0.25	0	0
	Nov. 17	0	800	0
	Nov. 18	0	16,000	1,000
	Nov. 20	0	24,000	8,000
	Nov. 21	0	26,000	0
	Nov. 22	0	44,000	670

The differential egg count in the feces of animal 191 showed the following eggs present in one fecal pellet: *H. contortus,* 627; *Ostertagia* spp., 10; *Trichostrongylus* spp., 180; *Cooperia spp.,* 19; *B. trigonocephalum,* 18; *Oesophagostomum columbianum,* 69; *C. ovina,* 5; and Strongyloides, many (not counted). There was apparently no effect on the production of larvae in the culture made the day after phenothiazine was fed, but no larvae developed the following day. Feeding of phenothiazine was omitted on Thanksgiving day (November 23, 1939) and consequently a few larvae developed in the culture made from feces collected on November 24; those that did develop were retarded. No more larvae developed in cultures, with the exception of those of Strongyloides, until three days after the drug feeding was discontinued.

Experiment 3

The effect of phenothiazine, fed at the rate of 0.25gm per day, on the development of nematode larvae in fecal culture was determined as follows:

Three days after the termination of Experiment 2, phenothiazine was fed to ram 199 for eight days at the rate of 0.25gm per day, administered in a molasses-grain mixture. The results showed that although the administration of phenothiazine at the rate of 0.25gm per day in the feed did not check the development of all nematode larvae present, the number of larvae developing was greatly reduced. Four days after the feeding of phenothiazine had been discontinued, the number of larvae developing in the cultures was normal. Details of Experiments 2 and 3 are given in Table II.

Experiment 4

The effect of phenothiazine, when added directly to the feces of sheep, on the development of nematode larvae, was determined as follows:

When it was found that the phenothiazine passing through the digestive tract inhibited the development of nematode larvae in the cultures made from the feces of treated sheep, it was decided to determine the effect of this drug on larval development when

added directly to feces of untreated sheep. For this purpose 1gm of phenothiazine was mixed thoroughly with 100gm of feces from a sheep having a pure infection of *H. contortus;* the mixture was placed in a culture jar for five days. Although a control culture made with feces from the same animal produced 50,000 infective larvae, none of the larvae in the test culture developed beyond the first stage.

TABLE III. LARVAE OF HAEMONCHUS CONTORTUS RECOVERED FROM 50-GRAM CULTURES OF SHEEP FECES TO WHICH PHENOTHIAZINE HAD BEEN ADDED

Grams of phenothiazine added to 100gm of feces	Larvae recovered	Remarks
2.0	0	
1.0	200	Many immature larvae
0.5	0	
0.25	800	Many immature larvae
0.13	4,000	Many immature larvae
0.00	20,000	All mature larvae

In the second part of this experiment, six 50-gram cultures were prepared, again using feces from an untreated sheep infected with *H. contortus* only. Graded amounts of phenothiazine were added to five of the cultures by placing the materials in a mortar and grinding it till the mixture was uniform. Phenothiazine was added to these cultures at the rate of 2.00, 1.00, 0.50, 0.25, and 0.13 grams, respectively. The remaining culture was used as a control, no phenothiazine being added. When the cultures were examined five days later, the control culture yielded 20,000 larvae while the others yielded decreasing numbers of larvae depending on the amount of phenothiazine added. No larvae were found in the two cultures to which 2.0 and 0.5 grams had been added. In the other test cultures many of the larvae were in the first and second stages of development, although all those in the control culture were in the third or infective stage. The culture to which had been added one gram of phenothiazine yielded only a few larvae, possibly indicating that a small particle of feces had escaped contact with the phenothiazine, thus allowing the development of a few larvae to the first and second stages. Detailed results of this experiment are given in Table III.

The results presented in Table III show that a greater quantity of the drug is necessary to inhibit larval development when mixed directly with the feces than when given to the sheep with the feed.

Discussion

The results obtained in this limited number of experiments agree with those reported by Gordon and Whitten,[4] except as to the quantity of phenothiazine sufficient to inhibit the development of nematode larvae in cultures made from the feces of sheep to which the drug had been administered in the feed. Gordon and Whitten gave the phenothiazine at the rate of 0.2 to 0.75gm per kilo of body weight, whereas in the present experiments the drug was given at the rate of 0.0082gm per kilo of body weight.

Whether phenothiazine administered to sheep in the quantity and manner indicated in these preliminary experiments, namely, 0.5gm daily in the feed, can be utilized, under field conditions, to prevent pasture contamination and thereby break the life cycles of the parasites, still remains to be determined.

Summary

Phenothiazine administered in gelatin capsules to one sheep at the rate of 7gm per day for three days and to two other sheep at the rate of 0.5gm per day in the feed for seven and nine days, respectively, completely inhibited the development of nematode larvae, except those of *Strongyloides papillosus,* in cultures made from the feces of these animals. This inhibition of larval development was manifested in the culture made from the feces 48 hours after the administration of the first dose of phenothiazine and continued for 48 hours after the last dose had been given. The number of Strongyloides larvae was reduced.

When administered at the rate of 0.25gm per day in the feed, phenothiazine failed to inhibit larval development.

Phenothiazine mixed thoroughly with sheep feces containing *Haemonchus contortus* eggs only, at the rate of 1% by weight, inhibited the development of all larvae. When mixed with feces in amounts of less than 1%, larval development was retarded.

[4] Gordon, Hugh McL. and Whitten, L. K. 1939.—A preliminary note on the anthelmintic efficiency of phenothiazine against *Haemonchus contortus* in sheep. *Jour. Council Sci. and Indus. Res.,* 12:3, p. 207.

Practical Methods of Poultry Disease Control

By J. R. CHRISTIAN, Woodhull, Illinois
and H. R. HORNBAKER,
Galesburg, Illinois

BECAUSE the poultry industry is so widely distributed, its size is not realized by many. It has been frequently stated that the annual production of the poultry industry in this country exceeds the wheat crop in value.

The mortality in the poultry industry is so high that few other industries could survive such a loss. Imagine operating any other business with a wastage of at least 30% of the invested capital yearly! The poultry industry cannot afford such a loss. Some hatcheries and remedy companies take advantage of this situation; supplying the poultryman with a quantity of remedies at the time he purchases his chicks at a cost equal to if not in excess of the price paid for the chicks. That practice adds to the cost of raising chicks and the poultryman does not get intelligent treatment for his birds when he needs it. An even greater problem in controlling poultry diseases in our locality is the so-called poultry expert whose education in regard to poultry consists of a few weeks of intensive training in salesmanship. He frequently makes a positive diagnosis with at most a casual examination, and sells the poultry owner sure-cure remedies after the fashion of the medicine show man.

Some veterinarians have been able to establish a poultry practice by offering free post-mortem examination and diagnosis of diseased poultry. This takes time, but the birds in many cases are brought to the office and the examination can be made when other duties permit. It affords the veterinarian a contact with the poultryman and an opportunity to serve him. Without this contact the owner would probably purchase some proprietary medicine about which he knew nothing or consult a poultry specialist (medicine peddler) with the usual result that follows medication without accurate diagnosis.

Some veterinarians are reluctant to give attention to poultry on economic grounds, but others have found, especially in the central states, that it pays to diversify their practice. A careful post-mortem examination and diagnosis of poultry diseases often leads to other calls.

Modern sanitary methods advocated by various state experiment stations and enforced by state laws governing commercial hatcheries, with the modern methods of pullorum testing, give the poultryman a chick that has a much better chance to live than the chicks of a few years ago.

Pullorum Disease

In spite of all the precautions that have been practiced to produce healthy, viable chicks, the veterinarian frequently encounters pullorum disease due to house infection traceable to old buildings that have not been properly disinfected. Like coccidiosis, coryza, perosis, parasites and trichomoniasis it is essentially a disease of young chicks. Material losses from this group of diseases seldom occur among adult birds.

After the premises have been completely cleaned they should be thoroughly scrubbed with hot water and lye (one pound of lye to five gallons of boiling water). The feeding utensils and brooder should be treated in the same manner and placed in the house. Place a vessel containing boiling

water on the brooder stove to increase the humidity in the room. Stretch strings across the house close to the floor. Dip cloths in formaldehyde and hang across the strings. There should be used at least 20cc of formaldehyde to 100 cubic feet of room space. The cloths should be hung at the farthest part of the room, working toward the door. When all the formaldehyde cloths are hung, close the doors tightly and keep closed for 12 hours. Air out for two days before placing chicks in the house.

Coccidiosis

Coccidiosis generally makes its appearance when the chicks are from four to eight weeks old, depending on the amount of ground infection. The bird presents a very depressed appearance with drooping wings, rough feathers and a crow-headed appearance. There is a general appearance of deficiency in the plumage. The excreta are generally streaked with blood. On postmortem examination blood is found in the intestine, particularly in the cecum. Specimens for microscopic examination should be taken from different parts of the intestine. The mortality is very high.

Where the premises are known to be infested with coccidia, the owner should be instructed to move the brooder house and clean the premises. He should be cautioned that the protozoan causing this disease can be carried on the shoes, and should be instructed carefully in regard to wearing rubbers and properly cleaning them to prevent spread of the disease.

Feed the chicks the following: wheat middlings, three parts; buttermilk, one part. After about four day return to the commercial feed for a day or two, and then go back to the buttermilk and middlings. This program should continue as long as the owner sees evidence of the disease. Iron and quinine solution, one ounce to the gallon of drinking water, should be used in badly infected flocks, and one ounce to two gallons of drinking water as the birds improve. Bichloride of mercury is used to prevent infection through the drinking water. If possible the birds should be placed on wire to avoid contact with the droppings and prevent reinfestation.

Coryza

Chicks 12 to 20 weeks of age are susceptible to two types of coryza. One type is due to overcrowding in small brooder houses without sufficient ventilation. The second type is caused by a deficiency in protein. The owner is responsible for this type by changing the feed of his flock abruptly from a balanced ration to a straight grain ration, from mistaken motives of economy.

For the first type, add iron and quinine in the drinking water. Inhalants can be used at night. Ventilation must be corrected. Instruct the owner to move the birds to larger premises.

For the second type, see that plenty of green feed, such as alfalfa meal, is supplied. It is usually necessary also to add meat scraps to the grain ration to make it 19% protein.

Perosis

Slipped tendon is generally caused by the flock owner's becoming overanxious to place the birds on the broiler market, and adding too much protein, usually semisolid buttermilk, to a balanced ration. The result is an imbalance of calcium and phosphorus; usually there is an excess of phosphorus. The birds walk base wide or base narrow. Sometimes they are unable to stand, and they sit down most of the time.

Reduce the protein to 19% and add manganese to the ration (One dram to 25 pounds of feed.) Gradually decrease the manganese as improvement is shown.

Parasites

Among the parasites that are listed as the most common are the roundworms and the tapeworms. Many birds harbor both. The physical appearance is one of general unthriftiness, showing some emaciation and paleness of the membranes. Mortality is high. Microscopic smears made from various areas of the intestine are a great help in determining the kind of parasites. In our experience the tapeworm predominates. The owner should move the brooder house to higher and clean ground and keep moving it if possible so the chicks will not be on bare ground. The house should be kept away from ditches, low-lying ground and water holes. Treating chicks once a month

with kamala and nicotine sulphate is very effective. Tetrachlorethylene with magnesium sulphate is also useful. The same treatment is used for birds infested with roundworms and is administered in the morning before the birds are fed.

Trichomoniasis

This protozoan disease is found in chicks and poults. The symptoms may be mistaken for blackhead. Autopsy reveals patches in the esophagus, proventriculus and gizzard. Spots, when scraped for specimen purposes, show a fungus in connection with the ameba, which is similar to mycelium.

Treatment includes sanitation; bichloride solution in a crumbly mash or added to the drinking water. Another treatment is one dram of tincture of iodine and one gallon of water. This is to be used to make a crumbly mash. One dram of iodine may be added to a gallon of drinking water.

When the chicks are ready for the laying quarters, check carefully for external parasites. The laying quarters should have been previously whitewashed and the roosts treated with black-leaf forty.

Laryngotracheitis

This and the five diseases discussed in the following paragraphs are prone to occur among layers. Predisposing causes are overcrowding and poor ventilation. The exciting cause is a filterable virus. This infection occurs in a very acute form with a rapid onset and high mortality. Isolate the birds visibly affected and use autogenous bacterin on the balance of the flock by the vent method.

Infectious Bronchitis.—At the onset this disease is not very acute but gradually a few of the birds become affected. The mortality, however, is not high. The owner says his birds have a cold.

Several palliative treatments are used, such as fumigation and sterilizing of the drinking vessels in mild cases. Sanitation and proper ventilation, along with a balanced ration, give good results. Where mortality warrants, resort to an autogenus vaccine administered by the vent method. The takes should be checked carefully in 72 hours.

Differential diagnosis between laryngotracheitis and infectious bronchitis is necessary. In laryngotracheitis there is a bloody streaked mucus in the air passages, which is not found in infectious bronchitis. In both diseases the sinuses are completely blocked with a cheesy mucus which extends down into the trachea and bronchioles.

Fowl Typhoid

This disease may be confused with fowl cholera. The season of the year and the age of the birds are useful in making a differential diagnosis; fowl cholera is seldom seen in dry, hot weather or in young chicks. Typhoid is slow in its onset. The birds are sick approximately two weeks before the owner becomes excited.

The symptoms include drowsiness, ruffled feathers, paleness, and green diarrhea. Birds are slow and move only when forced. Autopsy shows enlarged liver, dark in color with a greenish cast; small white spots on the liver might be mistaken for leucosis or tuberculosis. This disease is caused by a specific organism, *S. gallinarum*.

For treatment, specific vaccine is used with success.

Fowl Cholera

Fowl cholera is a very acute infectious disease of fowls, with high mortality. The high mortality and the weather conditions assist in making a diagnosis. Autopsy shows an enlarged, friable liver; the viscera show a septicemic infection.

To control fowl cholera, burn all dead birds, remove all present litter and droppings from the house. If weather conditions permit, spray roosts, drop-boards, nests and other equipment with a 10% solution of liquor cresolis in boiling water. Vaccinate all well birds on the premises with fowl cholera bacterin.

Leucemia

This is an infectious disease of domestic poultry. The causative factor is unknown. There are three distinct types, erythroid, lymphoid and neurotic. The neurotic type can generally be recognized in culling by the discoloration of the iris, which becomes gray to white in color. Other forms of the neurotic type show leg lameness and partial wing paralysis. In handling the flock,

examination and comparison show an atrophy of the lame leg. The same applies to the wing.

When leucemia has been diagnosed, remove all visibly affected birds. Caution the owner that the disease may be expected to recur. Be sure no mites are in the brooder house, and if possible hatch chicks from the survivors of this flock in order to raise the resistance of the flock. This method has been practiced in some flocks where the mortality ran as high as 25%. In four or five years chicks hatched from this flock showed no signs of leucosis, whereas in male birds added to the flock for breeding purposes the mortality ran as high as 50%.

Avian Tuberculosis

Tuberculosis is an acute, subacute or chronic disease of poultry. It is seldom recognized in birds less than one year of age but is commonly found in birds that are two years old or older. In badly infected flocks lesions and sometimes symptoms are found in younger birds. It is far more important in the Mid-West than most poultrymen realize.

The symptoms are unthriftiness, loss of weight, and lameness.

At autopsy, tubercular nodules are found in about 95% of the cases in the liver and spleen, less often in the viscera. Tuberculosis is controlled by the intradermal test, rigid culling, and placing the birds that pass the test on clean ground.

General Measures

Sanitation, rigid culling, and good judgment are absolutely necessary in controlling disease.

Brooder houses should be portable and moved frequently. This renders unnecessary much disinfecting that if undertaken at all is usually not complete. Old lots should be spaded and some crop planted.

Frequent cleaning and disinfection of houses, feed hoppers, and drinking fountains help in preventing the spread of disease.

Frequent culling eliminates the weak birds in the flock that would not in any case return a profit but might, because of lowered vitality, become spreaders of disease. Culling also helps to reduce overcrowding.

Anomalies of the Bird

A year-old, White Rock hen with one wing was observed recently.

On post-mortem examination it was found that the right wing was developed normally. The only normal development of the left wing was the scapula and the clavicle. The left coracoid was about one-half inch shorter than the right coracoid. There were no bony structures, muscles, or tendons representing the remainder of the wing. The skin was thickened and in the form of a rudimentary wing. The hen was normal in other respects and had been laying regularly. This anomaly was probably due to an embryonic stricture.

Dunn and Landauer[1] in 1925 described rumplessness in fowls. Their genetic tests showed two distinct causes: inheritance and embryonic strictures. Frequency of rumplessness is about one per thousand. Jenkins[2] in 1929 reported that rumpless fowls are relatively infertile.

Dunn[3] stated, "A keelless purebred White Leghorn cockerel was hatched in the spring of 1922. The cockerel was healthy, vigorous and active. The abnormality was not noticeable except when the bird was handled. This cockerel was bred in 1923 to four pullets with normal breastbones. From these matings 45 chickens were hatched, all being normal in every respect."

Grzimek[4] described a claw on the rudimentary second finger of a Leghorn cock.

In 1935 Maas,[5] in Germany reported that 11 black chickens having only one leg each were hatched from a clutch of 13. Either the right or left leg was fully developed, but only the femur of the other leg was present. Four males and three females survived and were quite healthy at the age of five months. A one-legged golden pheasant chick had been observed in the same district.

Marsh[6] in 1875 described birds with teeth.

VICTOR B. BEAT.

New Berlin, Ill.

[1] Dunn and Landauer, 1925. *Anat. Rec.*, 29:143.
[2] Jenkins, 1929. *Anat. Rec.*, 42-43:24.
[3] Dunn, 1924. *Jour. Hered.*, Vol. XV, 7:307-308.
[4] Grzimek, 19..... *Int. Rev. of Poultry Sci.*, 5:66.
[5] Maas, 1935. Animal Breeding Abstracts, 4:349.
[6] Marsh, 1875. *Amer. Naturalist*, 9:12.

The Effect of Hookworm Infestation On the Coagulation Time of Dogs' Blood

By MURRAY GREENSAFT
Bronx, N. Y.
and ROGER SPENCER
Columbia, Missouri

CLINICAL observation of hookworm-infested dogs has led to the common belief that the coagulation time of their blood is increased, and that they are, therefore, poorer surgical risks than hookworm-free dogs.[1] This study was undertaken in an effort to determine if infested dogs have a longer clotting time than non-infested dogs.

In a review of the literature we have not been able to find any articles on the effect of hookworm infestation on the coagulation time of blood *in vivo*. Loeb and Smith[2] (1904) found that extracts of *Ancylostoma caninum*, the dog hookworm, prevented the coagulation of dogs' blood *in vitro* for different periods up to 24 hours. Later work by Loeb and Fleisher[3] (1910) confirmed this. These workers found the anticoagulant in the anterior half of the worm.

Weil and Boyé[4] (1910) slowed the clotting time of rabbit blood with extracts of *Ascaris equorum*. Schwartz[5] (1921), using species of nematodes from the family Strongylidae, made a saline extract of the powdered parasite and mixed it with an equal part of blood. He found a delay of coagulation from the extracts of *Bunostomum phlebotomum, Bunostomum trigonocephalum, Strongylus vulgaris* and *Strongylus edentatus*. He found that the anticoagulant was present in both the anterior and posterior ends of the parasites and concluded that the absorption of these secretions is probably important in the pathogenesis of hookworm disease. In a later report of the same year Schwartz[6] (1921) records that salt-solution extracts of *Ancylostoma caninum* and *Bunostomum phlebotomum* do not inhibit the coagulation of rabbit blood to any marked degree.

Procedure

The animals examined were 30 stray dogs collected at random. Their coagulation time was determined by the following procedure. An incision was made over one of the superficial ear veins and a drop of blood was drawn into each of two glass capillary tubes with a diameter of one-half to one millimeter. These capillary tubes were made by heating one-fourth inch glass tubing over a Bunsen burner and then drawing it out to the desired diameter. At intervals of ten seconds after filling these capillary tubes, a small section was broken from the end and carefully pulled away from the remaining part of the tube. The coagulation time was recorded as the interval between the time blood appeared in the incision and the appearance of strands of fibrin between the

[1] Whitlock, J. H., 1939. Lecture notes in Applied Veterinary Parasitology, Kansas State College.
[2] Loeb, Leo and A. J. Smith, 1904. The presence of a substance inhibiting the coagulation of the blood in Anchylostoma. Proc. Path. Soc. Phila., n.s. 7:431-435.
[3] Loeb, Leo, and M. S. Fleisher, 1910. The influence of extracts of *Anchylostoma caninum* on the coagulation of blood and on hemolysis. *Jour. Infec. Dis.*, 7:625-631.
[4] Weil, P. Emile, and G. Boyé, 1910. Action of extracts of *Ascaris equorum* on the coagulation time of rabbit blood. *Compt. Rend. Soc. Biol.*, 69:284-285.
[5] Schwartz, B., 1921. Hemotoxins from parasitic worms. *Jour. Agr. Res.*, 22:379-433.
[6] Schwartz, B., 1921. Effect of secretions of certain parasitic nematodes on coagulation of blood. *Jour. Paras.*, 7:144-150.

broken sections of the tube. The clotting time for each of the two tubes was recorded separately.

Fecal examinations were made to determine the presence or absence of hookworm eggs. The concentrated sugar-flotation method was used. The fecal material was mixed with tap water, strained through coarse cheese cloth, diluted with an equal amount of concentrated sucrose solution, and then centrifuged for three minutes. The surface of the liquid was transferred to a glass slide by means of a wire loop and examined under low power. The animals were judged to be infested when one or more hookworm eggs were found.

Results

Of the 30 dogs examined 11, or 36.6%, were found to be infested with hookworms. The accompanying table shows the coagulation time in seconds of both tubes in each case and the average time for each animal. The clotting time in infested animals ranged from 60 to 240 seconds, with an average of 119.09. Those of the non-infested group ranged from 45 to 135 seconds, with an average of 82.63. Thus, it took on an average of 36.36 seconds longer for the blood of the infested group to clot, an increase of 44%.

For a check on the accuracy of the coagulation determination, the average of the minimum coagulation times and the average of the maximum coagulation times were compared. In the non-infested group the minimum was 10.52 seconds less than the maximum; that of the infested group showed a difference of 9.09 seconds.

Comments

These data tend to indicate that hookworm infestation in dogs increases the coagulation time of the blood. There are several uncontrolled factors, however, such as errors in technic, differences in the normal clotting time of individuals, hookworm infestation without the presence of eggs in the fecal sample examined, and differences in physical condition and nutrition of the dogs, that might have influenced the clotting time and impaired the accuracy of the results. Also, the limited number of animals used is not sufficient to prove conclusively that there is an increase in coagulation time in hookworm infestation in dogs.

This apparent increase in coagulation time may be due to the release into the blood stream of the animal of the anticoagulant substances proved to be present in the worms. However, other factors, such as anemia due to blood loss, with resulting lack of prothrombin, fibrinogen, or calcium, may be wholly or partly responsible for this increase in coagulation time.

Further study of this problem should include the examination of normal dogs, subsequently infested with hookworms and studied under controlled conditions. In this way, the change of the coagulation time, if any, could be ascertained with greater accuracy.

TABLE I. CLOTTING TIME OF INFESTED AND NON-INFESTED DOGS RECORDED IN SECONDS

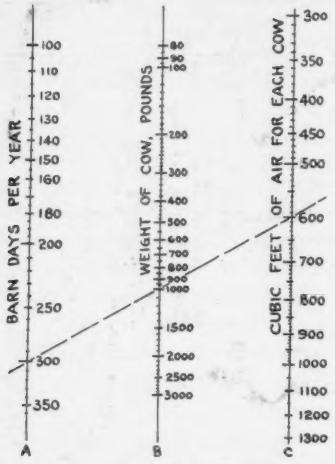
Case No.	Infestation	Non-infested Tube A	Non-infested Tube B	Non-infested Average	Infested Tube A	Infested Tube B	Infested Average
1	Negative	105	105	105.0	.....	.....	.....
2	Positive	.....	.....	.....	180	180	180.0
3	Positive	.....	.....	.....	240	240	240.0
4	Positive	.....	.....	.....	105	130	117.5
5	Negative	60	90	75.0	.....	.....	.....
6	Negative	90	90	90.0	.....	.....	.....
7	Negative	70	90	80.0	.....	.....	.....
8	Negative	110	120	115.0	.....	.....	.....
9	Positive	.....	.....	.....	70	70	70.0
10	Negative	90	105	97.5	.....	.....	.....
11	Negative	60	75	67.5	.....	.....	.....
12	Negative	75	75	75.0	.....	.....	.....
13	Negative	75	85	80.0	.....	.....	.....
14	Positive	.....	.....	.....	120	135	127.5
15	Negative	60	70	65.0	.....	.....	.....
16	Positive	.....	.....	.....	120	120	120.0
17	Positive	.....	.....	.....	105	110	107.5
18	Negative	120	135	127.5	.....	.....	.....
19	Negative	45	45	45.0	.....	.....	.....
20	Positive	.....	.....	.....	60	75	67.5
21	Positive	.....	.....	.....	60	90	75.0
22	Positive	.....	.....	.....	110	120	115.0
23	Negative	45	60	52.5	.....	.....	.....
24	Negative	60	60	60.0	.....	.....	.....
25	Negative	45	60	52.5	.....	.....	.....
26	Positive	.....	.....	.....	90	90	90.0
27	Negative	120	120	120.0	.....	.....	.....
28	Negative	70	105	87.5	.....	.....	.....
29	Negative	120	120	120.0	.....	.....	.....
30	Negative	50	60	55.0	.....	.....	.....
	Average	77.37	87.89	82.63	114 55	123.64	119.09

Summary

In a study of 30 stray dogs collected at random, it was found that 36.6% of them were infested with hookworms and the average coagulation time of the infested dogs was 44% longer than the average of the non-infested dogs.

Proper Amount of Barn Air for Any Cow in Any Climate

Regardless of climate and regardless of the cow, here is a chart that gives the number of cubic feet of air allowable in the cow barn. The chart is based on dependable



data and formulas developed by government specialists, college research, consulting engineers, and heating and ventilating engineers.

How many days per year is the cow sheltered in the barn? Find the number of days in column A. What is the weight of the cow? Find the weight in column B. Run a straight line through the "barn days," column A, and the weight of the cow in pounds, column B; the intersection of the line with column C gives the number of cubic feet of air allowable for that cow.

For example, the broken line drawn across the chart shows that in an extremely severe climate where the cow is sheltered 300 days out of the year, the weight of the cow being 1000 pounds, 600 cubic feet of air is required; this is equivalent to a space six feet by 14.3 feet by seven feet.

It is obvious that in order to arrive at the correct total volume of a given cow barn it is merely necessary to determine the cubic feet of air required for each cow and then add them together. Thus, if there are 250 barn days per year and if there are 10 cows weighing 800 pounds, eight cows weighing 850 pounds, six cows weighing 900 pounds, five cows weighing 1000 pounds, two cows weighing 1200 pounds, and one weighing 1500 pounds, the chart tells us that the answer is $(10 \times 620) + (8 \times 650) + (6 \times 675) + (5 \times 720) + (2 \times 810) + 950 = 21{,}620$ cubic feet. Knowing this, it is a simple matter to decide upon the dimensions of the barn.

W. F. SCHAPHORST, M. E.

Newark, N. J.

* * * *

Acetonemia and Post-Parturient Indigestion

Chloral hydrate is a specific with us for acetonemia. We give our Jersey cows six drams twice per day until they have four doses. Of course this is dissolved in a pint of water. This is specific and, for us, will cure every uncomplicated case. Occasionally more than four doses are necessary. We buy chloral in 50-pound lots and probably treat over 2,000 cases per year. As for post-parturient indigestion, I wonder if it isn't acetonemia in one of its many forms. If so, chloral hydrate will cure the digestive type of acetonemia as well as the nervous type, though as a rule it takes a little longer.—*Southwestern Iowa Veterinarian.*

* * * *

Fibrosarcoma in a Mule

History.—A smooth-mouth jack mule was presented for treatment with a history of having had nose trouble for several years. A diseased tooth and the nasal septum had been removed in an effort to correct the condition.

Symptoms.—When the mule was presented at the clinic the condition consisted of a purulent bilateral nasal discharge with a repulsive odor. The respirations were stenotic upon both inspiration and expiration. Passage of a stomach tube was difficult through the left nostril and impossible through the right.

Diagnosis.—Tumor obstructing nasal passages. No treatment was attempted because of the age of the animal, failure of previous surgical operations and apparent extensiveness of the growth.

Autopsy.—A large, firm, encapsulated growth was found occupying both the anterior and posterior maxillary sinuses on the right side of the head and extending into the dorsal and ventral turbinates, and into the posterior nares on both right and left sides. Microscopic examination identified the growth as a fibrosarcoma.

MORGAN W. TEMPERO.

Clay Center, Kans.

* * * *

Vegetative Endocarditis of the Aortic Valve in a Dog

Valvular disease of the heart, according to Cadiot, is found in 5% of all dogs over a year old; involvement of the aortic valve, however, is rarely seen. This condition may follow acute endocarditis or develop secondarily to some other chronic infection. It is apt to appear following such diseases as distemper, septicemia, chronic nephritis, bacterial invasion, especially by staphlococci and streptococci, and in dirofilaria infestation. Some predisposing causes which may constitute an important factor are exposure to cold, over-exertion, and traumatic influences.

January 29, 1940, a five-year-old male Boston terrier was presented for post-mortem examination with a history of having been sick for 10 days preceding death. The initial symptoms were rather mild and consisted primarily of irritability. The dog bit a child and a couple of dogs and was suspected of having rabies. Following excitement and physical exertion weakness, dyspnea, and cyanosis of the mucous membranes appeared. The dog became worse daily and three or four days preceding death edema in the subcutaneous tissue of the thorax developed. After the appearance of the edema, the dog failed rapidly and dyspnea became more and more severe until death occurred.

Post-mortem examination disclosed a hydrothorax consisting of 200cc of reddish yellow transudate, generalized edema of the lungs, and an edematous condition of the fascia and mediastinal tissue at the base of the heart.

In the intestinal tract a catarrhal enteritis and a small number of tapeworms and ascarids were found.

Examination of the brain for Negri bodies was negative.

The heart appeared slightly enlarged and the left ventricle was moderately dilated. The aortic semilunar valve was greatly thickened, the thickening being primarily due to a grayish-white, cauliflower-like growth of fibrous connective tissue involving two of the three semilunar cusps of the valve. The extensive growth on the valve was approximately one-half inch in diameter and extended into the aorta about three-eighths of an inch occluding one-half of the lumen.

The growth on the valve was such as to have two effects: first, imperfect closure of the valve, resulting in a backflow of blood from the aorta; secondly, partial stenosis of the lumen of the aorta, resulting in an interference with the exit of the blood from the left ventricle. As a result of the impaired flow a stagnation of the blood occurred in the heart and lungs, and there was a subsequent edematous infiltration of the surrounding tissues. The resulting edema in the thorax and lungs no doubt embarrassed the physiological function of the lungs to such an extent as to cause suffocation.

The cause of the endocarditis was unknown.

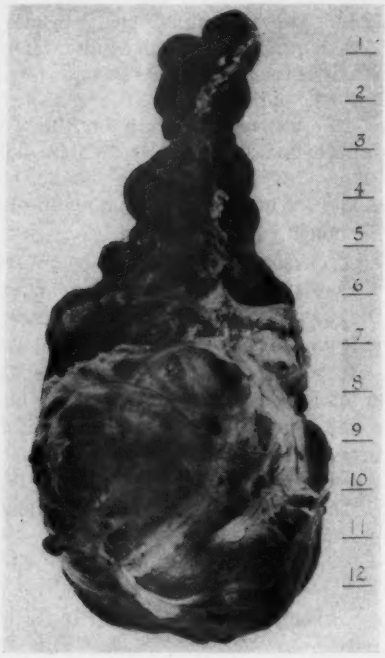
CARL ERICKSON.

Philadelphia, Pa.

Animal Hospital of E. A. Rodier, Oakland, Calif. Doctor Rodier will be remembered as assistant secretary (1938) of the A. V. M. A. He spent 10 years in the Kwangsi Province, Southwest China, in charge of rinderpest control measures.

Multiple Hematomas in the Spleen of a Dog

Recently the veterinarian in charge of the Station Veterinary Hospital at Ft. Riley, Kans., presented an enlarged spleen to the Department of Pathology of Kansas State College for diagnosis. The spleen was from a nine-year-old female Llewellyn English setter.



The spleen described in this report. It was greatly enlarged, with a grey necrotic area near the center.

This dog bad been brought to the Station hospital at various times during a period of six months preceding its death. The only histoory given by the owner was that he had noticed a gradual onset of such symptoms as droopiness, weakness, anemia, discomfort, and rapid exhaustion. The abdomen was tense and the patient showed pain on palpation. The temperature was normal during the entire period of illness and the appetite also was about normal. The patient was in relatively poor condition but not seriously emaciated.

At one time, three months prior to death, the animal was very weak and almost comatose. Treatment at that time was symptomatic and consisted of glucose injections and force-feeding of liver and concentrates. After several days of this treatment the animal seemed to be regaining health. However, the improvement was only transitory and the patient became gradually weaker, soon reaching the point where it became difficult to make her stand on her feet, and death followed.

Post-mortem examination revealed a greatly enlarged spleen. No other tumors were found and there was very little ascites.

The spleen was gourd shaped, weighed 4.4 pounds and was dark in color. There was a grey necrotic area about five centimeters in diameter near the center. A melanotic tumor was suspected, but microscopic examination proved the enlargement to be due to multiple hematomas.

F. L. BUENTE.

Evansville, Ind.

* * * *

Stable Fly a Source of Trouble

At times the stable fly (*Stomoxys calcitrans*) becomes excessively abundant and occasions heavy losses among nearly all classes of live stock. Year in and year out it is a source of great annoyance, especially to horses and cattle, and is an all-too-common and persistent pest.

The adult stable fly resembles the house fly, but is slightly broader and feeds principally on the blood of animals, which it draws with its long, piercing mouth parts. It breeds in accumulations of various kinds of vegetable matter and also in manure, especially when the latter is mixed with straw. When strawstacks become wet soon after threshing the flies breed in the fermenting straw, and it is these conditions that produce the severe outbreaks.

Spraying animals with repellents is not very satisfactory, but the numbers of stable flies can be kept down by caring properly for stable refuse and by stacking or otherwise disposing of the straw.—*U. S. D. A. Bull.* 1097.

Book Review

Chemistry and Medicine. *Edited by Maurice B. Visscher,* Professor of Physiology at the University of Minnesota. Cloth bound; 296 pages, illustrated. The University of Minnesota Press, Minneapolis, 1940. $4.50.

Although this work deals exclusively with basic sciences of medicine and does not touch clinical veterinary medicine at all, it is nevertheless a work of extraordinary value to veterinarians. It comprises a series of papers presented on the program commemorating the 50th anniversary of the founding of the Medical School of the University of Minnesota (Oct. 12-13-14, 1939).

The general theme of the work, "Some Trends in Medical Progress with Particular Reference to Chemistry in Medicine," was chosen because it represents one of the most recently developed and more rapidly expanding aspects of medical science.

While all the articles deal with basic chemistry, physiology and physics and are therefore important contributions to the science of veterinary medicine, the following discussions hold the greater interest for veterinarians:

"Organic Chemistry in the Pursuit of Vitamin Research," by Lee Irvin Smith, Professor and Chief, Division of Organic Chemistry, University of Minnesota, 44 pages.

"On the Necessity of Fats in the Diet," by George O. Burr, Professor of Botany and Physiological Chemistry, University of Minnesota, 20 pages.

"Heparin and Thrombosis," by Charles H. Best, Professor of Physiology, University of Toronto, 16 pages.

"Recent Chemical Trends in the Study of Immunity," by Michael Heidelberger, Associate Professor of Biochemistry, College of Physicians and Surgeons, Columbia University, and Chemist to the Presbyterian Hospital, New York, 18 pages.

"The Biology of Animal Viruses," by Robert G. Green, Professor of Bacteriology, University of Minnesota, 28 pages.

"The Mode of Action of Sulfanilamide and Its Derivatives," by Perrin H. Long, Associate Professor of Medicine, Johns Hopkins University, 27 pages.

"Chemistry in Urinary Antisepsis," by Henry F. Helmholz, Professor of Pediatrics, The Mayo Foundation, University of Minnesota, 11 pages.

The keen interest in vitamins makes the discussion of Professor Smith particularly welcome. It is introduced thus:

In the field of vitamins and hormones we deal with substances which exert profound biological effects by their presence in very minute amounts. It may, therefore, be said with some reason that in this field we approach rather closely the idea, advanced by Berzelius many years ago, that life phenomena are essentially catalytic. Be that as it may, it is true that there exists a large numberof substances—called variously vitamins, hormones, and enzymes—whose action is very much akin to the action of catalysts; and these terms—vitamins, hormones, and enzymes — while fairly definite in themselves, might logically be regarded as special classes of a very large group of substances which have as yet no widely accepted name but which might be called biological catalysts. As yet all of the substances clearly belonging in these groups are organic in nature, but it is quite within the bounds of possibility that there exist inorganic substances which exert profound effects in such small amounts that they might almost be called *inorganic vitamins.* Indeed substances of this nature are already known in connection with both plant and animal metabolism.

The following table, listing vitamin discoveries, constitutes useful reference material:

TABLE I.—Discovery of the Vitamins

Vitamin	Existence Established	Isolation	Synthesis	Designation
A	1912–15	1928	1937	Vitamin A
B	1912–15			
B_1	1912–15	1926	1936	Thiamin
B_2	1933	1933	1935	Riboflavin
P-P	1925–26	1937	1867	Nicotinic acid amide
B_6	1936	1938	1939	Vitamin B_6
C	1919	1932	1933	Ascorbic acid; cevitamic acid
D	1922	1927	1927*	Calciferol
E	1922	1936	1938	Tocopherol (α, β, γ)
K_1	1936	1939	1939	Vitamin K_1
K_2	1939	1939		Vitamin K_2

* Not a true synthesis from simpler substances. As the organic chemist understands the term, vitamin D has not yet been synthesized, although its structure is known with a great deal of certainty.

The author subdivides the study of a vitamin into five stages ([1] recognition of the biological effect; [2] location of foodstuffs rich in the vitamin and experimental production of the disease state; [3] isolation; [4] determination of the structure and synthesis; [5] testing of structurally related compounds in order to find a simpler compound of as high or higher activity, search for the chemical mechanism where-

by the vitamin operates in the body, and application of the vitamin to the treatment of disease, human and animal), and proceeds with an illuminating discussion of each stage.

Contending with vitamins for first place in interest to scientific medicine are the viruses, and the discussion of this subject by Doctor Green, a frequent contributor to veterinary literature, is no disappointment. Essentially he pleads for a new approach to the study of viruses:

Concepts of disease.—Men first believed that disease was a manifestation of possession of an individual with a demon, and consequently early human medicine concerned chiefly methods of casting out devils. This theory of disease persisted for many centuries and was discarded only after the discovery of microbes and the proof that they caused certain infections which spread from one person to another. Since the time of Koch and Pasteur whole sciences have developed that are based upon the discovery of microbes and their relationship to infection. Nevertheless our basic concept of disease has changed but little. Human beings are the center of our interest and we still interpret disease in terms of its effects on man. We have failed to recognize that microbes are species of life ordered by nature in reproduction and survival, and that their activities represent primarily the life history of biological species, representing disease only secondarily, from the viewpoint of animal or human welfare. For sixty years we have conducted detailed studies on microbes. We have learned to differentiate one species from another and have discovered that certain ones, upon invasion, cause specific symptoms. We have even carried on intensive research on chemical changes that occur as the microbes grow. However, we have given little attention to the activity of microbes as a means of perpetuating their species and to the effect of parasitic life upon the microbes themselves.

In the discussion that follows the virus occupies the center of the stage. Since a virus cannot be studied by observation the discussion turns to the life history of the parasite, the host becoming merely the environment—a highly advantageous approach to the subject.

The other discussions, like those of vitamins and viruses, are presented by leading authorities in their respective fields and contain the latest scientific advances. The titles in themselves—sulfanilamide, immunity, etc.—must intrigue the searcher for knowledge in the field of medicine.

Bureau of Animal Industry Merges Biochemic Division, Other Units

Dr. John R. Mohler, Chief of the Bureau of Animal Industry, U. S. Department of Agriculture, has announced the merging of the Biochemic Division of that Bureau with two other major units. Most of the employees will be assigned to the Pathological Division and the remainder to the Animal Nutrition Division. All lines of the Biochemic Division's work will be continued under these units. The change becomes effective July 1st.

The Biochemic Division, staffed by about 20 scientific workers, is well known in research and livestock fields for many important discoveries and services. Notable among them are the discovery of anti-hog cholera serum, production of tuberculin for the nation-wide campaign against tuberculosis in live stock, and the development of stained antigen for the detection of pullorum disease in poultry. The Division likewise has developed or improved dips and disinfectants for combating animal diseases and parasites, and has conducted productive research in the nutritive value of meats and animal fats.

For economy and convenience of administration, activities of the Biochemic Division that relate to animal diseases, including the preparation of tuberculin and other biological products, will be assigned to the Pathological Division. The work relating to nutritive value of animal products will be under the Animal Nutrition Division. The principal offices of the Pathological Division are in the Administration Building of the Department of Agriculture in Washington, whereas the nutrition work is conducted principally at the Beltsville Research Center, Beltsville, Md.

* * * *

A survey of 780 of the living graduates of one of the older veterinary colleges revealed their occupations to be as follows:

Practice	65%
Federal Work	12%
Education	5%
State and Municipal Employ...	5%
Army Veterinarians	3%
Research	3%
Commercial Work	7%